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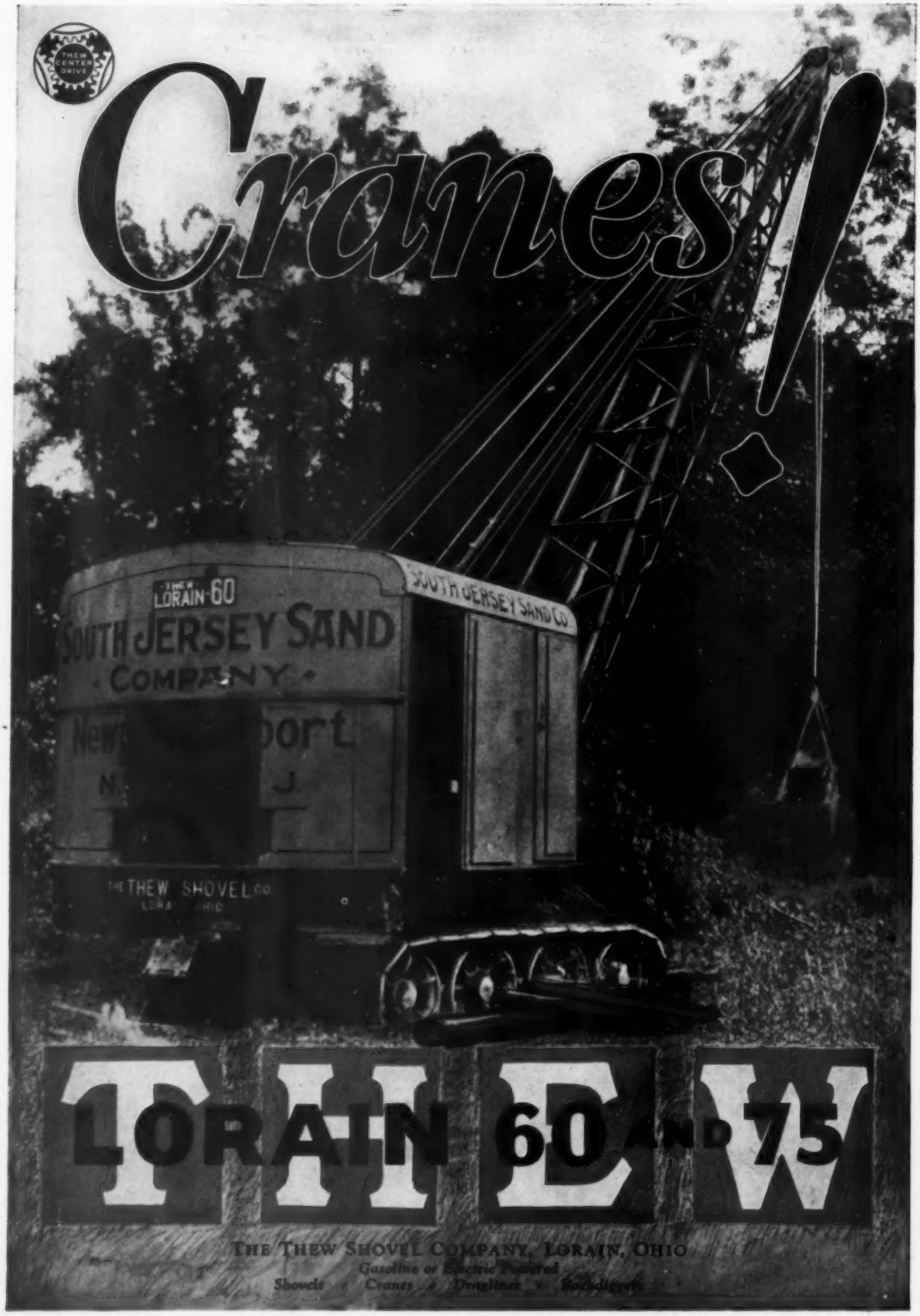

Please mention the CONTRACTORS AND ENGINEERS MONTHLY—it helps.

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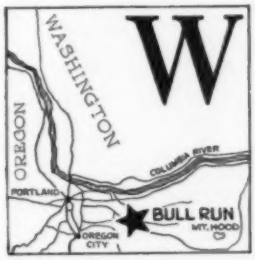
The Bull Run Dam

By L. T. Grider

General Superintendent, Bent Brothers, Inc., Los Angeles, Calif.



WHILE primarily for storage of domestic water for the city of Portland, Oregon, the Bull Run Dam is equipped with the necessary penstock, namely, two 96-inch-diameter riveted steel pipes to serve a hydro-electric power unit to be built at some later date. The dam is of a gravity type and is also arched in plan. The structure is 1000 feet long by 200 feet high and will require about 240,000 cubic yards of concrete and about 100,000 cubic yards of excavation to complete.

The dam is located on the Bull Run River about 40 miles east of Portland and 8 miles south of the Columbia River. On an air line, it is about 15 miles from the base of Mt. Hood. The Bull Run basin is heavily wooded and for this reason, together with its being so near the mountain which is always covered with snow, there is an almost unbelievable amount of rain fall. In the winters of 1926 and 1927, there was about three times the rain at the dam site that there was at the city of Portland. In the month of September, 1927, there were 13 inches of rain, which was three times the normal for September.

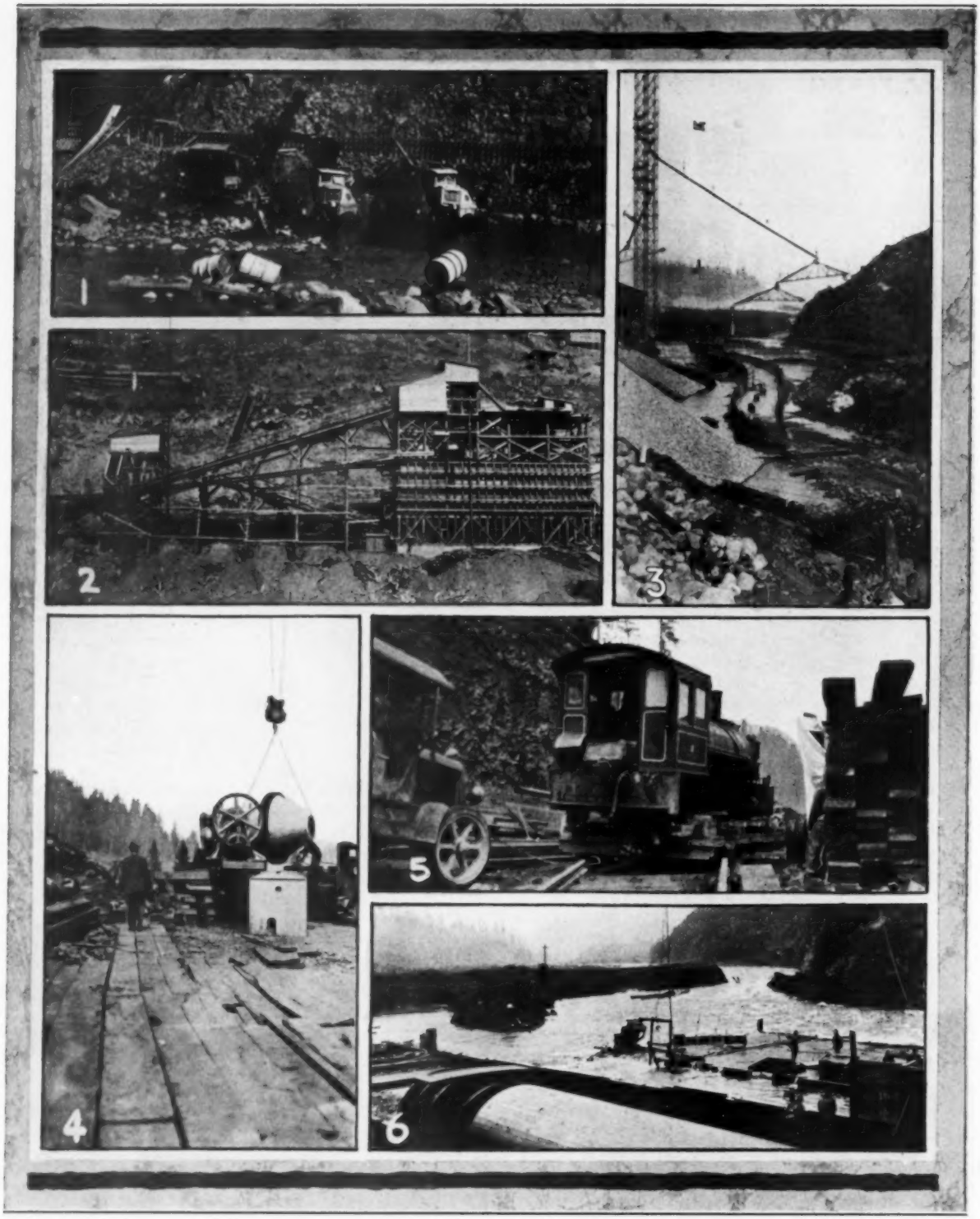
Aggregate Difficult to Secure

One of the difficult problems of this job was to get the necessary rock and sand to be used for concrete. After a very thorough investigation of all the gravel deposits downstream from the dam for a distance of 3½ miles, we decided we could build about 4 miles of railroad in the bottom of the canyon just in the clear of floods, and by taking all the available gravel we could find with the possibility of having to add a small amount of fine sand. Sand and gravel are loaded by a 2½-cubic-yard Monighan dragline into 12-cubic-yard Western air-dump cars and then hauled the 3½ miles to the dam site where they are washed, crushed and screened in the various sizes to be used in the dam. The hauling requires 3 trains of 3 cars each and they are pulled by three 18-ton Vulcan locomotives.

The gravel, screening, crushing and washing machinery was practically all furnished by the Bodinson Manufacturing Co. of San Francisco and Los Angeles, and a great part of it is the same equipment used on the Exchequer Dam recently completed. The Bodinson Manufacturing Co. sold this machinery to Bent Brothers for the Exchequer Dam, overhauled it in their San Francisco plant and sent it on the Bull Run Dam.

There are three crushers used: one Farrel-Bacon jaw crusher, 24 x 36 inch, crushing to 6 inches; one No. 6 Champion jaw crusher, crushing to 2 inches; one No. 3 Simons cone crusher used to produce sand. The rock sizes range from ⅜ to 9½ inches and 30 to 35 per cent of the total aggregate is rock 3½ to 9½ inches.

Part of the Railway to the Gravel Pit. All Timber in This Trestle Was Cut from Trees at the Site of the Trestle



CONSTRUCTION SCENES ON THE BULL RUN DAM PROJECT

1. The P & H No. 700 1¼-yard gas shovel and Mack trucks at work on foundation excavation. 2. Gravel plant of 100 tons per hour capacity furnished by Bodinson Manufacturing Co., San Francisco, consisting of one No. 3 Simons cone crusher, one 24 x 31- inch Farrel-Bacon crusher and one No. 6 Champion jaw crusher. 3. Insley double-compartment tower concreting plant with 20-inch spouting used in concreting the flume which will carry 3000 second-feet. 4. Unloading a 2-cubic-yard Smith mixer, using a Washington Iron Works cableway. 5. Three of these Vulcan locomotives of 21 tons each were hauled 12 miles with truck and trailer to the job. 6. One of three floods in September, 1927. Concrete is now across the river, so this cannot happen again.

CONCRETE PLANT

Attached to the gravel bunkers are steel measuring boxes of the proper capacity to give us the required amount of each size rock. These boxes were designed and used by us at our Exchequer Dam.

In addition to rock measuring boxes, we have two Blaw-Knox sand inundators of the proper size for a 2-cubic-yard mixer. As the sand is coarse and also because we use a large amount of cobbles we found the sand, when inundated, carried too much water for the mix and therefore we were forced to devise a scheme to dehydrate the sand. This dehydration has caused us untold trouble and is not worked out to our satisfaction as yet, for now it takes one man for each inundator and that man is very busy.

The rock and sand measuring boxes are dumped into two Insley rocker dump cars of 86-cubic-foot capacity and are pulled thence to the mixing plant, a distance of 180 feet by one 4-ton Plymouth gas locomotive. Each car contains the proper amount of the various sizes of rock and sand and water to charge the 2-cubic-yard mixers.

The cement storage is located on a floor above the aggregate car level and is dumped through a steel chute direct into the mixer at the same time that aggregate cars are dumped. There are two 2-cubic-yard Smith tilting mixers located near the base of the double compartment steel tower and these mixers dump almost directly into the two concrete skips.

The 380-foot steel tower and 20-inch chuting are all of Insley make and were sold to Bent Brothers by Garfield & Co. of San Francisco for use on the Exchequer Dam. This equipment, with very little repair, was moved from Merced to Bull Run for it fitted this job perfectly. The concrete hoists are two 150-horsepower Thomas hoists, sold to Bent Brothers by Garfield & Co.

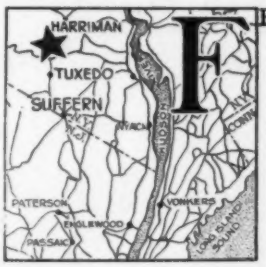
EXCAVATION

The excavation for the dam was peculiar, inasmuch that the major part lay at the top ends of the dam instead of in the bottom, as it usually is, so we decided to drag the lower parts of the sidewall excavation into the bottom by means of two Bagley scrapers dropping it where it can be picked up with a gas shovel that is working in the bottom. This shovel loads trucks which haul the excavated material about 1000 feet downstream from the dam. The upper part of the sidewall excavation will be loaded with the same shovels later on into trucks which haul along the hillside about 600 feet and dump over a rock wall just above the dam.

The two shovels are Model-700 P&H gas shovels with 1¼-cubic-yard buckets. The Monighan dragline and the three locomotives are steam powered. The two shovels and 30 h.p. Best tractor are gas operated, but all the rest of the power, about 1200 horsepower, is electric. To get this electric power, we had to build our own transmission line about 11 miles at a cost of about $20,000.

There is a 5-ton cableway that crosses over the dam from end to end and with this machine we can handle any equipment, lumber, steel and men, back and forth over the work, landing anywher eon the dam, or over the truck road at the north end of the dam. This cableway has worked almost night and day since the start of the job. This work was started early in March, 1927, and we expect to have it completed by December 31, 1928.

A New York State Heavy Traffic Road



FEDERAL Aid projects assume considerable lengths in the West while in the East where heavier traffic is expected they are more likely to be of greater widths and shorter lengths. Projects 8256 and 8258, built during the 1927 construction season on New York State Highway No. 17 from Suffern, N. Y., at the New Jersey State line north to Harriman, has been pushed with energy by the contractor and has provided an interesting example of the use of modern construction equipment as well as a contrast in the remarkable service of a seventeen-year-old road roller.

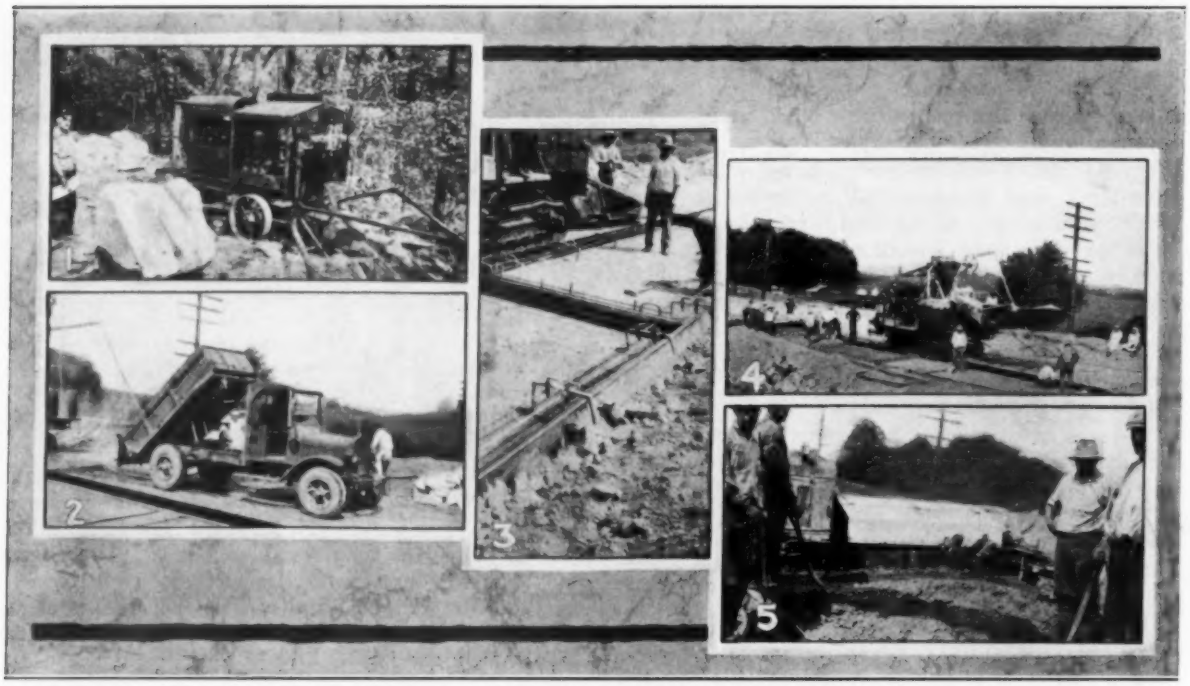
Project 8256 was 3.91 miles long and 27 feet wide, built in three 9-foot strips with thicknesses of 8 to 7 inches on the outer strips and 7 inches for the center strip reinforced with Truscon mesh and reinforcing bars. Project 8258 was 5.10 miles long and consisted of sections 18 feet and 27 feet wide. The 27-foot sections are similar to those on F. A. P. 8256 and the 18-foot sections are 8-7-8 inches thick. Work was started on grading these two projects on August 4, 1926. Some concreting was done in that construction season but the greater part was done in 1927. Work was practically completed on Project 8258 on October 1 and on 8256 on November 1, 1927.

The Waterbury Concrete Construction Co., Meriden, Conn., was the contractor on both projects which were built under the jurisdiction of J. S. Bixby, State District Engineer, with E. W. Dayton and H. E. Feldman in direct charge of Projects 8256 and 8258, respectively. The story of the equipment and methods employed is told in the three accompanying illustrations.

WORK CONTINUED IN 1928

North of the project described above, work was begun in 1927 on realigning Route 17 to eliminate a number of unnecessary curves and some preliminary grading was completed. During the construction season of 1928, several additional miles of this highway will be under contract by the New York State Highway Department. This is an important thoroughfare, running from New York City, through New Jersey, and then through Suffern, N. Y., to Harriman and north and west to Goshen, Middletown, Monticello, Deposit, Binghamton, Owego, Elmira and Corning, N. Y., more than half way across New York State.

On the work done in 1927 great difficulty was experienced with handling the traffic over a detour which was originally little better than an oiled macadam and which with the heavy pounding of truck and bus traffic and the constant stream of passenger cars, quickly be-



EQUIPMENT USED ON THE WATERBURY CONCRETE CONSTRUCTION COMPANY'S JOB ON ROUTE 17, BETWEEN TUXEDO AND HARRIMAN, N. Y.

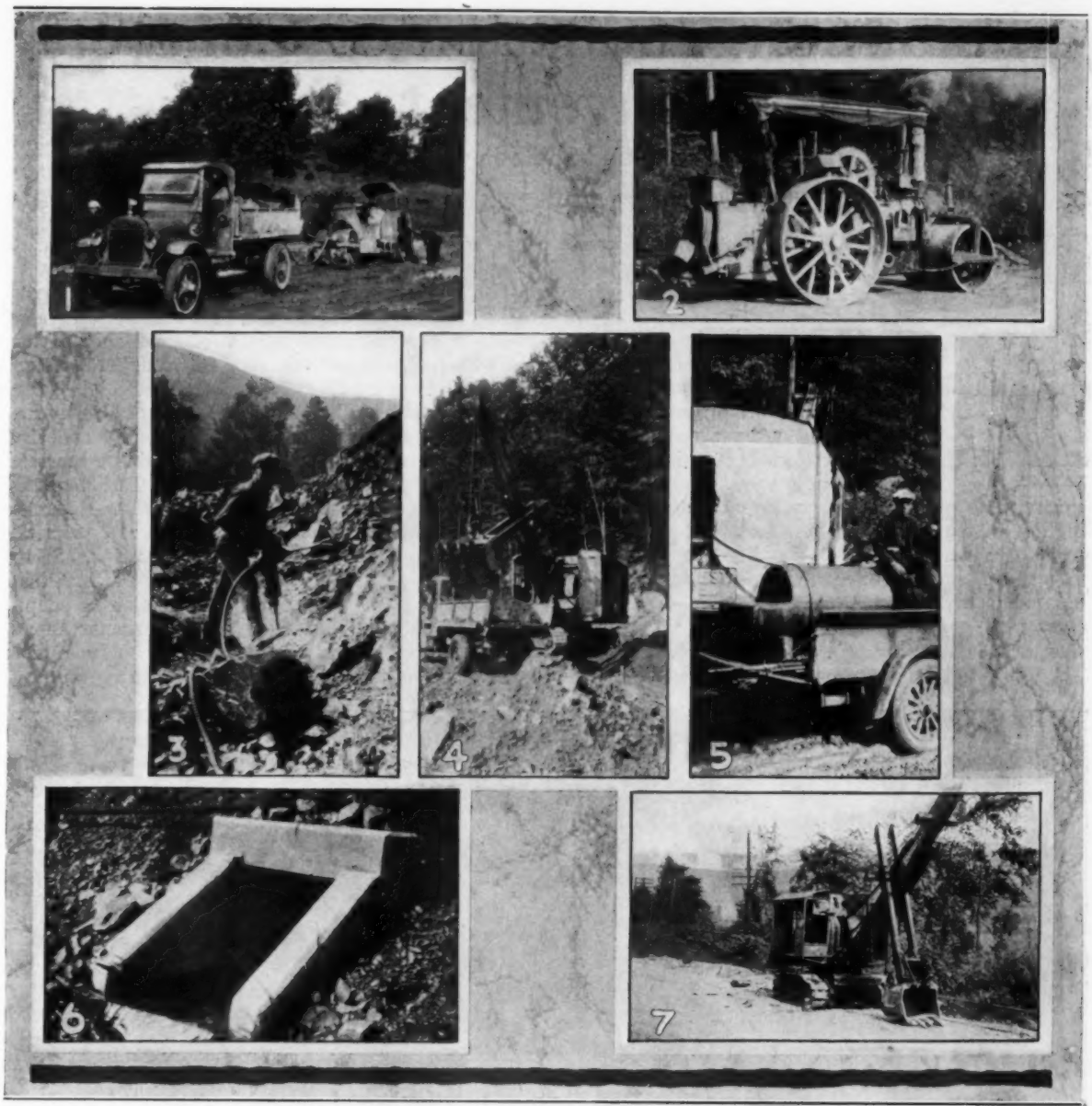
1. Barnes Triplex pump which supplied water to the entire job. 2. One of the Mack trucks equipped with Heil hoist which delivered aggregate and cement to the mixer. 3. Method of supporting the Truscon reinforcing bars at the edge of the pavement and at the Elastite expansion joints. 4. The Rex paver, Ord concrete finisher starting the last strip. 5. The Ord concrete finisher working while the laborers rest.

came a series of potholes. Progress over this detour was so slow that cars proceeded single file at a speed scarcely ever faster than 5 miles an hour.

Along the work in 1928 the new roadway crosses the

SUBGRADE WORK; THE FINISHED GRADE ON THE HARRIMAN JOB

1. Cement covered with tarpaulin lined up along the subgrade in August and September, waiting for the incessant heavy rains to cease. 2. The steel road forms. 3. The Huber Super-4 gasoline road roller which was continually at work compacting the final grade. 4. One of the causes of lost time and money on this job, a bad washout on the finished subgrade.



PREPARING THE GRADE ON THE HARRIMAN JOB

1. *A Mack dump truck helping the Huber Super-4 gasoline roller out of a soft spot on the subgrade.* 2. *A 17-year-old Buffalo roller bought in March, 1927, by the Waterbury Concrete Construction Co. from the town of Marlboro, N. Y.* 3. *One of four Ingersoll-Rand Jackhamers on the job, breaking down the ledge.* 4. *A Northwest shovel loading a Mack truck.* 5. *Graham Brothers truck with a gasoline tank fueling the Northwest shovel.* 6. *A typical concrete box culvert on this job.* 7. *The P & H Model-600 gas shovel which handled its share of the excavation effectively.*

old in several points so that it will probably be possible to maintain traffic for a considerable portion of the time over the present bituminous road with little inconvenience either to construction or to traffic.

An Imposter

WE are informed by a distributor of construction equipment that contractors and distributors should be on the lookout for a man, James Allen, who represents himself as a Material and Technical Engineer connected with the Southern Sand and Gravel Co., Atlanta, Ga., and who is an imposter. This man is about five feet, six and one-half inches tall, is rather heavy set, of light complexion, has dark hair, and has a very good knowledge of all contractors' and road building equipment. It is the custom of this man, it is said, to make an appointment after office hours and attempt to cash checks or borrow money. Should this man make his appearance at any contractors' or equipment dealers offices, police authorities should be notified immediately, so that his practices will be stopped.

Maximum Production of Concrete Pavement

By C. M. Hathaway

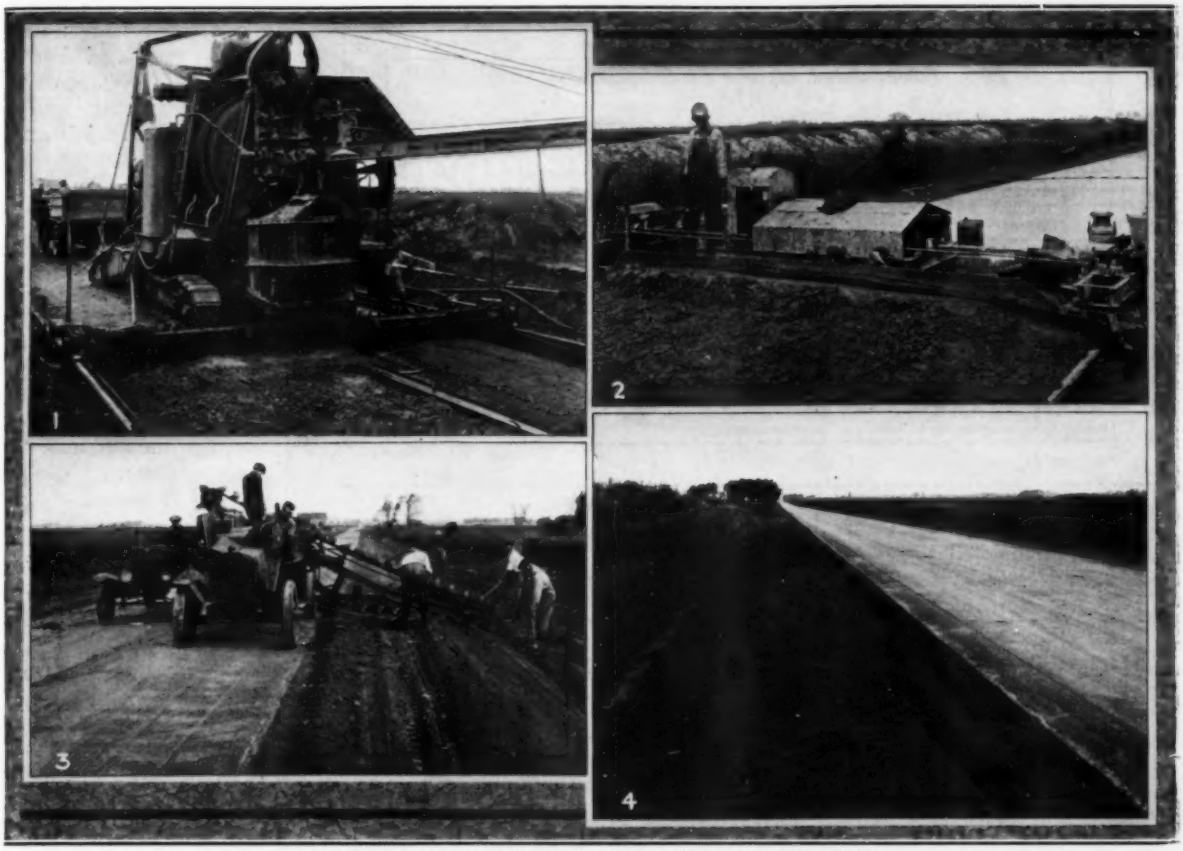
Engineer of Construction, Illinois Division of Highways, Department of Public Works and Buildings

THOSE familiar with concrete pavement construction recognize the rapid strides which have been made during the past ten years in quality, production, equipment, hauling methods and organization of contractors' forces. Seven or eight years ago the average performance of a good contractor was rarely over 500 square yards of standard concrete pavement per working day of ten hours, and one outfit was rated as capable of constructing five to six miles per year. Consider also the matter of equipment. Contractors, often unfamiliar with the best construction methods, were confronted with all kinds of untried machinery and were at a loss in making the most practical selection. The final purchase was more often than not influenced by over zealous salesmen, who were interested primarily in selling their machinery without much study whether or not it was adapted to the particular job. Transportation equipment was purchased on about the same basis. A superintendent capable of handling a paving job with economy and efficiency was considered a real asset.

The extensive paving programs of the past few years by the several states, augmented by county and city work, have done much to build up and stabilize concrete construction practice. Contractors and machinery designers alike have devoted much time to a careful study of adaptability of equipment, plant layout, practical hauling methods and efficency of organization. Salesmen on their part have come to realize two things: that the sale of a piece of machinery depends on its adaptability to the job; that the average contractor knows equipment, its merits and its defects. Much new paving machinery has been developed during the past

SOME OF THE EQUIPMENT USED ON THE FIRST JOB ON ILLINOIS' $100,000,000 BOND ISSUE SYSTEM

1. *Elevating grader loading three-up dump wagon.* 2. *Back view of Lakewood subgrader which operated ahead of the mixer.* 3. *Carr Formgrader on Route 115 north of Piper City.* 4. *The Koehring crawler crane loading Blaw-Knox steel bins.*



ADDITIONAL EQUIPMENT AND THE FINISHED JOB

1. Koehring 27-E paver. Note the center joint, longitudinal rods, transverse steel and subgrade template. 2. The finishing machine in operation. 3. The truck-mounted shoulder finishing machine which proved so economical. 4. View of the finished 30-foot roadway and 6-foot shoulder.

five years, only to be redesigned or even discarded as experience has shown its economic uselessness on the average job. A satisfactory paving outfit is now a well balanced plant in which each unit is designed to operate with maximum efficiency with the other units, and efforts are more or less directed to improvements in the units from the standpoint of economic plant operation rather than in the development of new machinery.

It is markedly noticeable that manufacturers and jobbers are co-ordinating so that instead of each manufacturer promoting his own sales, equipment is sold through supply houses handling several products—generally the jobber can furnish the machine best suited to the "plant."

CONTRACTOR NOW KNOWS WHAT HE WANTS

At the present time the average contractor knows exactly what earth moving machinery, what size water pump, what method of haul, the proper number and size of storage bins, and the type of mixer best suited to his own particular job. Frequently he refuses to bid on a project which is not adapted to his outfit rather than to undertake the proposition at a loss. The experienced contractor now has an organization, and the principals are generally "full time" men who have been working for years on pavement construction. He has learned the value of going over the work in the field and studying such points as water supply, average haul, ruling grades, material sources, railroad sidings, switching service, plant arrangement and such other features as might be classed as preliminary investigation.

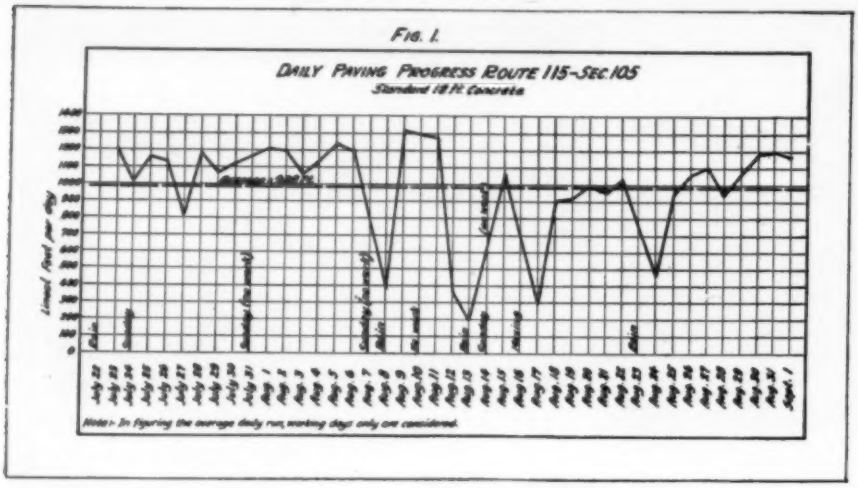
The development of many new paving contractors has brought about very close competition, and this also has made it necessary that the bidder consider every factor where a cent or two per square yard may be lost or saved. A job can easily be lost due to careless figuring or, in an endeavor to underbid his competitor, a contractor may estimate the job at a loss. These last two features cannot be too strongly emphasized, as they of themselves have done much to make the responsible paving contractor carefully analyze all the costs of the job.

In Illinois it is now common practice to estimate a daily run of 1,500 square yards of standard 18-foot concrete pavement of the "Bates type section," and the contractor who does not contemplate a yearly paving program of ten to twelve miles for one 21-E or 27-E paving outfit is rightly judged as not of first-class rating.

1927 CONSTRUCTION

Each year brings forth some unique job, some new achievement, and some unusual construction problem solved, and while the year 1927 is not as outstanding as the banner year 1924, for the total mileage completed, nevertheless it is not lacking in some new features. Primarily it marked the beginning of construction on

FIG. 1.



the One Hundred Million Dollar Bond Issue System, which when completed, together with the Sixty Million Dollar Bond Issue System, will give Illinois approximately 9,800 miles of paved highways. This may be said rightly to be the year's real achievement.

One of the most outstanding jobs during 1927 from the standpoint of production and efficiency in contracting methods was that located on State Bond Issue Route 115 between Route 8 and Kankakee. It began just south of Piper City and extended northerly twenty-one miles, and was awarded as a combination bid of three sections to the Regenhardt Construction Co. of Cape Girardeau, Mo. Small drainage structures and grading work were included in the contract. The award was made April 4th and the time limit set as December 1, 1927.

PROGRESS CHART

In accordance with standard Illinois policy, before the award was made, the contractor was required to furnish a progress chart on which he stated definitely the date each principal feature of the work would start —grading, culverts and pavement. He indicated his plant set-ups, point of beginning on each, water supply, and listed the weekly progress which he anticipated from each set-up. Such a chart is of inestimable value on all jobs to both the contractor and the engineer, since it furnishes a complete check on the progress of work at all times.

As this particular contract involved more than the usual yearly program for one paver, it was apparent that the contractor should have been required to place two complete outfits on the job. At his request, however, as backed up by past performance, he was permitted to start the work with one outfit, with an understanding that if a satisfactory rate of progress was not maintained, and a definite mileage had not been completed by mid season, additional equipment would be placed on the job to insure completion.

It will be interesting to know that the contractor estimated paving to begin April 20th, and that it actually started on May 17th, this due to the extremely wet weather which prevailed during the early spring months. On August 15th a comparison of actual progress with the chart schedule showed that the amount of pavement completed had nearly reached the estimated figure. Therefore it was apparent that the one outfit would complete the entire job and no additional equipment was required.

This is an instance where the contractor figured on extra working hours to accomplish a job which ordinarily should have required two complete paving units. With one outfit and a slight increase in organization he planned to increase production 50 per cent, thus avoiding the purchase of additional equipment.

GRADING

The topography was generally level, and earth excavation averaged 5,800 yards per mile. Rough grading was handled by two elevating graders, using eight dumps to each outfit. With this equipment from 6,000 to 7,000 cubic yards per week could be moved, and as a result the first set-up was graded and clear for paving in record time. This was the *first point scored* for maximum production, an item often disregarded by contractors: realization of the fact that nothing is more detrimental to paving progress than being held up by a grading outfit or trying to operate trucks or other equipment through earth-moving operations.

CULVERT CREW

A complete culvert crew with a 1-sack mixer handled the small culvert work, and this too was kept well in advance of paving operations: *point number two.*

SEPARATE BRIDGE CONTRACT A PROBLEM

One serious problem confronting the contractor was the fact that there were nine large bridges which had been awarded as a separate contract to another firm. It was manifestly impossible to get these structures completed and backfills made for paving before the mixer could reach them; therefore, some scheme must be evolved. The situation was met by the construction of temporary timber structures and detour roads of short length around each bridge job. It was also necessary at each bridge to leave a short gap in the pavement which was paved at a later date. Again, the contractor showed his realization of the fact that money thus spent was insignificant when compared with the cost of a few days shut down and loss of time in the paving schedule while waiting for bridge completion. *Another point,* too; *number three*: the contractor, in planning his work, foresaw the delay which might confront him on account of this bridge construction, and with the idea of production in mind he arranged his schedule so that all interfering features were reduced to a minimum.

PAVING PLANT

As soon as the grading operations and culvert work

would allow, the mixer was started. Incidentally, this particular job had the distinction of being the "first pavement laid" on the One Hundred Million Dollar Bond Issue System.

"Standard" paving equipment was used throughout; a 21-E paver handling a 5-sack batch, although later a new 27-E paver was placed on the job, thus permitting a 6-bag batch which increased production materially.

LABOR WELL HANDLED

A careful observation indicated that the equipment on this section was no different from that of the average paving job and the men employed seemed to be of ordinary caliber. This fact was apparent: the foreman in charge of each special feature of the work knew exactly what he was supposed to do and he trained each man to his particular duty. There was noticeably no harangue of the laborers by anyone. Back of the mixer, for instance, as soon as a batch of concrete had been deposited, the puddlers knew exactly what to do with it. The spaders went ahead with their work and the finishers completed the pavement, while a few hundred feet back, several men placed the burlap and saw that the surface was kept wet. Each man was an independent cog properly working in his appointed place. There were approximately 16 men employed on the subgrade and 30 men at the mixer.

At the proportioning plant a crawler crane handled the unloading, and a steel storage bin with separate compartments for coarse and fine aggregates, and automatic measuring boxes for each, delivered the materials to the trucks. Cement was loaded at the plant either from the storage shed or direct from the cars. Sixteen 2-batch and two 3-batch trucks handled the hauling adequately.

"LONG-HOUR" PAVING SHIFT

Realizing that a maximum daily production was necessary for the completion of this job as planned, the contractor immediately started a "long-hour" paving shift. Another *important point* for any paving contractor: an appreciation of the value of getting maximum production during the early months rather than letting the outfit run behind and then trying to catch up later on in the season. Working hours from sunrise to sundown during the months of June, July and August are productive of much greater output than can be obtained by working extra time during the months of September and October. The contractor never attempted to use a double or night shift, although his working hours varied from 13 to 14, according to the season.

In Figure 1 is shown a curve of the daily output of this outfit during part of July and August while maximum production was obtained. In Figure 2 the contractor's weekly rate of progress is shown.

CURING

Calcium chloride was used in curing and, in accordance with standard practice, the road was thrown open to traffic in twenty-one days.

FINISHING SHOULDERS AND CULVERT

Appreciating the value of getting each mile 100 per cent completed and accepted at as early date as possible, the contractor followed up his paving operations with shoulder and entrance culvert work as soon as permissible.

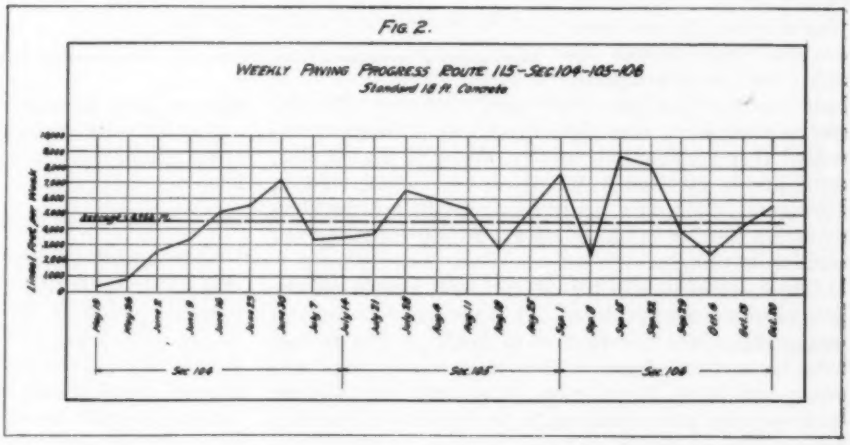
In finishing shoulders a new piece of equipment was used,—a special machine developed by another contractor. It consisted essentially of an endless belt equipped with buckets much similar to those of a ditching machine. These were mounted on a frame so that the excavating side could be adjusted to the true shape of the shoulder from the edge of the pavement to the berm line. This apparatus was rigidly attached to a large truck and was operated by an auxiliary engine. The dirt taken out by the buckets was deposited in a dump truck which traveled alongside. An operator and truck driver comprised the crew. As the shoulders varied in width from 6 to 13 feet in different sections, this machine saved a great amount of hand trimming, slip and grader work, and although I am not in a position to state its efficiency on every job, yet in this particular soil it served very satisfactorily.

It must be borne in mind that this outfit cannot be used until all the shoulder earth, with some excess, is roughly in place. Slips or wheelers were first necessary to "rough in" the shoulders. The machine merely performed the task of shaping, which ordinarily has to be done by other special machinery or by hand and line.

Probably this contractor did not obtain the largest daily run or largest season's production ever attained in Illinois, yet for the year 1927 his outfit will undoubtedly rate as the one laying the most pavement per day, per week, and total for the season. Special credit for handling this job must be given to the superintendent, William M. Regenhardt.

The contract was awarded by the Department of Public Works and Buildings, Division of Highways, Colonel C. R. Miller, Director; Frank T. Sheets, Chief Highway Engineer, and was under the direct super-

FIG. 2.



vision of District Engineer M. J. Fleming. R. G. Kenyon was Resident Engineer on the job.

THE MORAL

As before stated this job does not illustrate any particularly unique equipment or methods of operation, but it does furnish a definite lesson to the contractor and the engineer in showing what can be done with a complete organization handled by a superintendent who has carefully figured out certain daily production, and who by his own efforts, through an ordinary working season, has been able to keep production up to his estimated progress. It also points out certain important features to consider on any paving job, and it teaches a definite lesson of what may be accomplished by any contractor when he has a large mileage of work to complete in a season, and has only one paving unit to do it with. It proves that an ordinary paving plant may be made to work 12 to 14 hours per day by a proper organization of the labor unit. It also illustrates the several points discussed in the first pages of this article, namely—the ability of present-day paving contractors to handle a maximum yearly production, because the contracting organization has elevated itself through experience and study to a higher plane of efficiency and economy. There is no doubt that such production must, to a definite degree, influence the prices which are being secured for paving work in Illinois today. With a standard paving plant, the contractor may produce more work per unit than ever before, thus cutting down such items as cost of additional equipment, depreciation, overhead and obsolescence.

The Health of the Man on the Job

HEALTH in the construction industry may not be different from other fields of endeavor and yet there are certain factors that favor and others that disfavor the health of the construction worker. The worker is usually a rather healthy individual to begin with made so by the natural processes of elimination. Only those who are able to withstand the physical effort, as well as the effects of the out-of-doors with its varying weather conditions, can remain long at this work.

On the other hand, there are many who start young in years and in good health who become expert, efficient workmen, who over the years acquire all the usual ailments which result in ill health and poor production. Statistics show us that 3.5 per cent of the 38 million people gainfully employed in the United States are constantly ill and disabled, and of this number half remain on the job. This means that over 1,300,000 workers are ill at any given time. It is further estimated that at least half of this illness is preventable, according to Dr. Carl A. Wilzback, Ferro Concrete Co., Cincinnati, Ohio, in a paper presented before the Construction Section at the National Safety Council Convention in Chicago.

Those workers who are ill and still remain on the job furnish a real problem. It is generally recognized today that there are degrees of health. The worker who is in a low degree of health does not react normally and is apt to be surly, his attitude on questions to be decided is not what might be expected of one in a happy state of health, and there is many times an unwillingness to cooperate.

TWENTY YEARS OF MAXIMUM PRODUCTIVITY

The average health span or period of physical freedom and full vigor after maturity is between the ages of 18 and 31. That is to say, there are only 13 years after maturity on the average that the worker is free from disease. The work span, or period when men can compete in industry on a fair basis of equality, is from 20 to 40 years. These periods are far too short, especially when one remembers that the life span at the present time is about 58 years. The rapid accumulation of physical defects, the rapid lowering of physical resistance and working capacity with advancing years, reflect conditions and processes that should be controlled by the application of intelligent care of the body and rational adjustment to work.

While it is true that progress is being made, that the average worker is better paid, has more of the luxuries of life, is more intelligent, enjoys a better health state and lives longer than at any other period in American history, there is no reason why the present health conditions can not be improved. We must advance.

It is a generally accepted view today that the body does not simply wear out; it is infected out, poisoned out, starved out, or deficiencied out. A condition is produced in the body which changes it chemically. In disease there is a tendency toward acidity, and death is said to result from acidosis. The factors that produce the above conditions have been combated successfully in dealing with lower forms of life, and much can be done to help man in his fight for a longer, healthier existence.

INFECTIONS REDUCE EFFECTIVENESS

Infections, acute and chronic, head the list of factors that influence health as the most potent cause of disease, the epidemic infections being chiefly responsible in the early years of life; but chronic infections later appearing as a tremendous pathological influence, this type of infection working insidiously and radiating from foci in the teeth, tonsils, middle ear, nasal sinuses, prostatic urethra, gall bladder and appendix. It pays to search long and earnestly for some foci of infection

especially in individuals who do not respond normally to the accepted treatment.

BALANCED RATIONS NECESSARY

Food deficiency is still a big factor in the health of men in the construction industry, and there is a great need for educating the worker to the need of a mixed diet, including the mineral, vitamin, amino-acid and regulating foods. The effects of diet on certain diseases have been known for a long time, but the newer knowledge of nutrition indicates that many other diseases are also caused by a lack of certain food elements. It is urged by these experts that there be included for adults daily a mixed diet that contains at least a quart of milk, leafy vegetables and a certain amount of raw vegetable food. If these principles are adhered to the remainder of the balanced ration can be derived from milled cereal products, tubers, root vegetables, sugar and meats.

DO YOUR WORKERS TAKE POISON?

Poisons are a factor in the health of the worker and it is questionable what effects some of the drugs used as cathartics plus all sorts of proprietary preparations will occasionally have upon the body when taken daily and over a long period of years. Headache tablets, tea, coffee and tobacco also come under the heading of substances which may poison the individual. Alcohol is increasingly being found to be a factor in producing poisoning. Aside from the chemical impurities contained in the poorly made present day moonshine, there has lately been found copper in quantities large enough to produce metallic poisoning and over a long period of time cirrhosis of the liver.

SLEEP—BUT NOT ON THE JOB

Relaxation and sleep after the day's work are most important for workers in the construction industry. The speeding up of the work and worker has increased the strain both physically and mentally and this often results in an over-fatigued individual who is not fit for the job. Recreation and hobbies that lead to different channels of thought and action are needed. While there are exceptions, the average construction worker needs exercise as does the clerk or business man. All sorts of malconditions result from loss of sleep, chief of which are stomach symptoms with indigestion and loss of weight. There can be no doubt that the push of modern construction plus the worry of paying for the car and the newly purchased home are some of the major causes of these conditions. There should be special effort made to stress the need of at least eight hours rest for all workers, and more if one is below par physically.

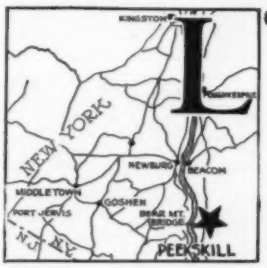
Modern Blasting in Quarries and Open Pits

WITH the idea in mind of rendering service to users of explosives by furnishing data accumulated from the field and other authoritative sources in an accessible form that will be available for practical use, the Hercules Powder Co., Inc., Wilmington, Del., has recently published "Modern Blasting in Quarries and Open Pits," by J. Barab. It is a book of 169 pages, copiously illustrated with photographs and diagrams, with an attractive cover of pyroxylin coated fabric containing Hercules nitrocellulose. The price of the book is $3.00.

The information contained in this interesting volume has been gained by a technically and scientifically trained man who has had much practical experience in industrial blasting of every description. The subject has been treated from many angles, and the book is the result of long and careful study. There has been included a short account of the history and theory of explosives, types of explosives manufactured, and blasting accessories. Principal attention, however, is given to actual results obtained in the field and discussions regarding the various methods employed.

The following subjects have been dealt with in this book: Explosives—Historical; Explosives Reactions; Explosives in Present Use and Their Properties; Blasting Accessories and Their Use; Drills and Drilling; Blasting Methods; Blasting by the Tunnel Method; Hercoblasting; Limestone Quarries Here and There; Blasting for Trap Rock, Ballast, and Gravel; Water Power Projects, Shale, Sand, and Silica Quarries, and Gravel Pits; Quarrying for Cement Rock and Flux Stone; Strip Coal Mining; Open Pit Copper Mining; Open Pit Iron Mining; Technical Records; Keeping Records of Quarry Blasts; How to Increase Production and Lower Production Costs; Cost Reduction Through Accident Prevention; Magazines.

An Economical Plant Layout



LOWELL GROSSMAN & CO., Poughkeepsie, N. Y., were the contractors on Federal Aid Project No. 3150, built during the 1927 construction season, as a portion of the reconstruction program leading toward better facilities for traffic on the east shore of the Hudson River north of Peekskill, N. Y., near the junction of the Bear Mountain Bridge connecting road. A central proportioning plant in Peekskill furnished the batches for the mixer on the job. The plant consisted of a Northwest crane which unloaded stone from the barges from the Tompkins Cove quarry of the New York Trap Rock Co., at Marlboro, N. Y. The aggregates were loaded into bins equipped with a 4-batch Erie Aggremeter.

The contractor had a large fleet of Mack trucks with Heil hoists to haul the batches to the road where a Koehring 21-E paver placed the mix. Blaw-Knox steel road forms, Elastite expansion joint and National steel fabric reinforcing were used. A Lakewood finisher tamped and screeded the mix to the proper contour after which it was belted and hand trowelled. A Buffalo-Springfield roller effectively compacted the subgrade before pouring. At the south end of the 3.27-mile job, a C. H. & E. road builders' pump furnished water through a pipe line to the mixer and for wetting down the earth and straw cover while curing. The remainder of the story will be found in the illustrations.

River transportation coupled with a well-balanced unloading plant made this central proportioning plant efficient. The contractors own fleet of trucks was ample at most stages of the work to handle the batches from the plant to the mixer. When additional trucks were needed a fleet was hired from a local hauling contractor. Lowell Grossman was his own superintendent on the job and kept his organization at top efficiency.

CENTRAL PROPORTIONING PLANT AND CONSTRUCTION SCENES ON THE LOWELL GROSSMAN JOB

1. Central proportioning plant on Hudson River showing Northwest crane and four-batch Erie Aggremeter. View taken from stone barge in the river. 2. Central proportioning plant from the land side. 3. CH&E road builders pump which furnished water for the mixer on the entire job. 4. Koehring 21-E paver and Lakewood finisher on the last day of the job. 5. One of the Mack trucks with Heil hoist which served the mixer. 6. Laborers spreading mix ahead of the Lakewood finisher.

The work north of Peekskill consisted of 3.27 miles of 27-foot pavement laid in three strips, the outer two of which are 8 to 7 inches thick and the center strip 7 inches thick. The work was done under the supervision of J. S. Bixby, District Engineer, with A. C. Pearce as Engineer in direct charge of the project.

Accident Prevention a Material Handling Problem

"IN the building industry, in the past, accident prevention has not been so much a machine problem as it was a problem in handling materials and handling persons. Nevertheless, the machinery problem has been increasing in the building industry owing to the greater use of machinery. However, there is far greater use of machinery in manufacturing today than ever before. So the fact that more machinery is being used does not prove that you cannot reduce the accidents. We have done that in manufacturing with more machinery than ever before. It is quite evident that things are not at all satisfactory in the building industry, and that something definite and positive ought to be done to tackle this problem."—*James A. Hamilton, Industrial Commissioner of New York State.*

A Great Construction Disaster

Failure of 250-Foot St. Francis Dam of Los Angeles Water Works Greatest Recent Loss

BETWEEN 12.00 and 12.30 on the morning of March 13, 1928, the great St. Francis Dam of the Los Angeles water supply system failed suddenly and devastated the San Francisquito Valley, turning a fertile country into a desolate stretch of sand and silt. Ralph W. Stewart, Chief Deputy City Engineer of Los Angeles, and the Editor of CONTRACTORS AND ENGINEERS MONTHLY were in the San Fernando Valley and rushed to the scene of the disaster, arriving well before noon. The most available point to start inspection of the flooded area was at the Harry Carey Ranch north of Saugus. To reach the dam at that time was impossible without a 70-mile trip through mountain roads.

The accompanying photographs are some chosen from a large group taken during the morning and show the extent and nature of the damage. At the Carey Ranch the waters were fully 65 feet high and one-third of a mile wide. According to a published report of California State Engineer, Edward Hyatt, Jr., the collapse of the great structure must have been almost instantaneous, liberating a 100-foot wall of water, which swept down the valley at the rate of about a mile in 45 seconds.

Erosion as far as 7 miles below the dam was fully 15 feet deep and the deposits of sand and silt were from a mere covering to over 40 feet in depth. The great force of the water is shown by the fact that it moved a section of the concrete dam weighing fully 5,000 tons a distance of nearly ½ mile downstream.

The effect of a great body of water moving down a confining canyon can well be imagined by the average man, but when the damage west of Saugus at a distance of over a half mile from the main bed of the Santa Clara River where the flood emptied into that stream is considered it passes the ability of man to appreciate. Tall, well-built steel transmission towers were felled and twisted like so much paper. Galvanized iron posts 1½ inches in diameter, supporting woven wire guard fence, were bent over like thin wires. The lowest diagonal of one of the transmission towers was bent several inches out of line by the blow from the carcass of a horse carried on the flood wave.

The concrete sub-station of the Southern California Edison Co. was demolished when the overflow from the river swept across the meadows between it and the river. A section of the highway running west from Saugus and connecting with the Ridge Route to Bakersfield was washed out, not by the rush of the flood, but rather by the ebb waters, as the whole direction of wash was toward the river. This is shown particularly by the corrugated iron culvert which was swept out from the road for 20 feet with the concrete headwalls still intact.

DETAILS OF DAM

The dam was completed in April, 1926. It was a simple gravity arch concrete type built by the Los Angeles Water & Power Bureau between Power Plants No. 1 and No. 2 of the Los Angeles Aqueduct in the San Francisquito Canyon. It had a storage capacity of 38,000 acre-feet, approximately 12 billion gallons, which could be used in years of heavy run-off to save water that would otherwise be wasted. The dam was 650 feet long. The maximum height was 250 feet, including a depth of 30 feet below the stream bed. The base thickness was 176 feet. One hundred and seventy-five thousand cubic yards of concrete were used in the construction of the dam, and it had a gravity section arched on a 500-foot radius. At the time of the failure the reservoir was full, the water having a maximum depth of about 150 feet and extending about four miles above the dam.

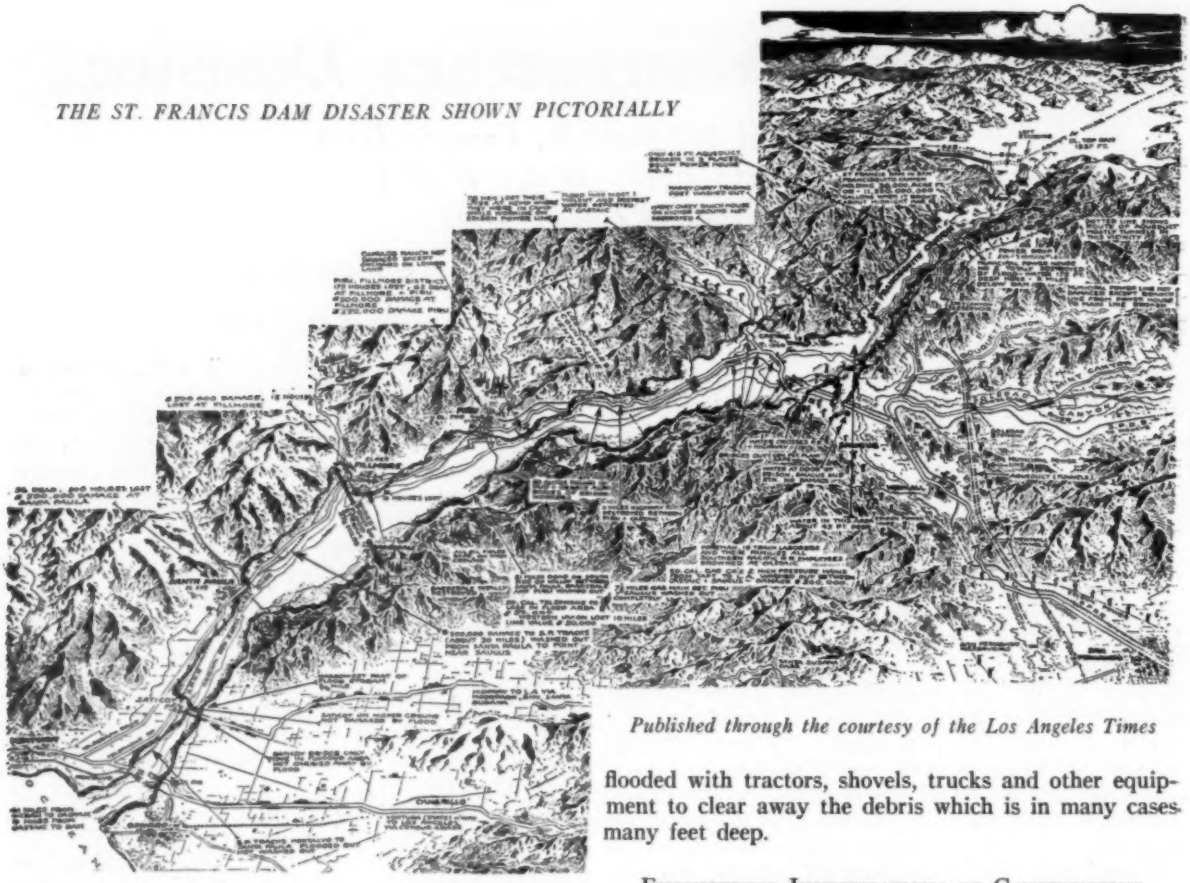
CAUSE OF FAILURE

The rock supporting the dam at the sides and bottom has been described, in testimony before the coroner's jury, as "schist" and "slate" somewhat softer than the masonry of the dam. Failure evidently occurred by displacement of the material which supported the ends of the dam. A 75-foot section of the dam near its center was left standing, both ends being totally collapsed.

Leakage had been coming through the rock under the west end of the dam and this leakage had been inspected for sediment but had been pronounced clear water, free from evidence of erosion, and within the limit as to quantity which could be expected. Testimony before the coroner's jury is to the effect that an inspection of

Close-Up of St. Francis Dam After it Collapsed on March 13, 1928.

THE ST. FRANCIS DAM DISASTER SHOWN PICTORIALLY



Published through the courtesy of the Los Angeles Times

the leakage which was made by engineers of the city's water department the day before the collapse, was made in response to a request for such inspection by employees in charge of the property. The dam at this inspection was considered safe.

INVESTIGATIONS

Several independent reports will be made by investigating bodies and verdicts rendered soon. A preliminary report of the Committee appointed by Governor C. C. Young, states that the soft supporting material of the dam contributed to its failure. The Committee is composed of the following men: Frank Bonner, California representative of the Federal Power Commission and District Engineer of the United States Forest Service; H. T. Cory, Consulting Engineer of Los Angeles; Frederick H. Fowler, Consulting Engineer of San Francisco, and A. J. Wiley, Consulting Hydraulic Engineer of Boise, Idaho. Dr. Elwood Mead, Commissioner of Reclamation, has been asked by the Los Angeles Chamber of Commerce to act as Chairman of a Committee of Engineers chosen from the American Society of Civil Engineers.

REHABILITATION

Rehabilitation work in the destroyed area is progressing rapidly. Arrangement has been made with the Los Angeles branch of the Associated General Contractors of America to clear away debris from the areas formerly improved and to reconstruct destroyed buildings at cost. Workmen have gone into the section flooded with tractors, shovels, trucks and other equipment to clear away the debris which is in many cases many feet deep.

ENGINEERING INVESTIGATIONS OF CONSTRUCTION

Published engineering reports made by competent observers who have visited the site of the St. Francis Dam since travel was possible in the valley, have pointed out that the rock on which the dam was built apparently softened under the hydrostatic pressure of the impounded waters behind the dam. The absence of a cut-off wall and the fact that the foundation rock was not grouted were all factors in permitting the failure of the dam by sliding when the head was only slightly greater than it had been when the reservoir was filled one year previous.

The failure of the rock under hydrostatic pressure has been pointed out by more than one engineer as an indication of the need of an additional test of rock particularly in non-glaciated areas wherever foundation may be subjected to water pressure.

That the concrete was sound has been shown by examination of fragments of the dam where the aggregate has been sheared through, indicating that the concrete was well mixed and had cured completely. Further, the portions of the dam in contact with the foundation rock when washed out tore away some of the foundation rock, showing that at least the bonding was strong. It is difficult to believe that there was carelessness in the design or construction of the St. Francis Dam. Apparently, there is need of a new line of research in rock materials, such as was indicated years ago when rock was blasted from the Panama Canal and was later found to soften under the influence of air and moisture. In the case of the Panama Canal, it was

merely in cuts and not at points where structures subjected to hydrostatic pressure were to be built. At the St. Francis Dam site this somewhat similar softening was undoubtedly the cause of the failure and consequent devastation.

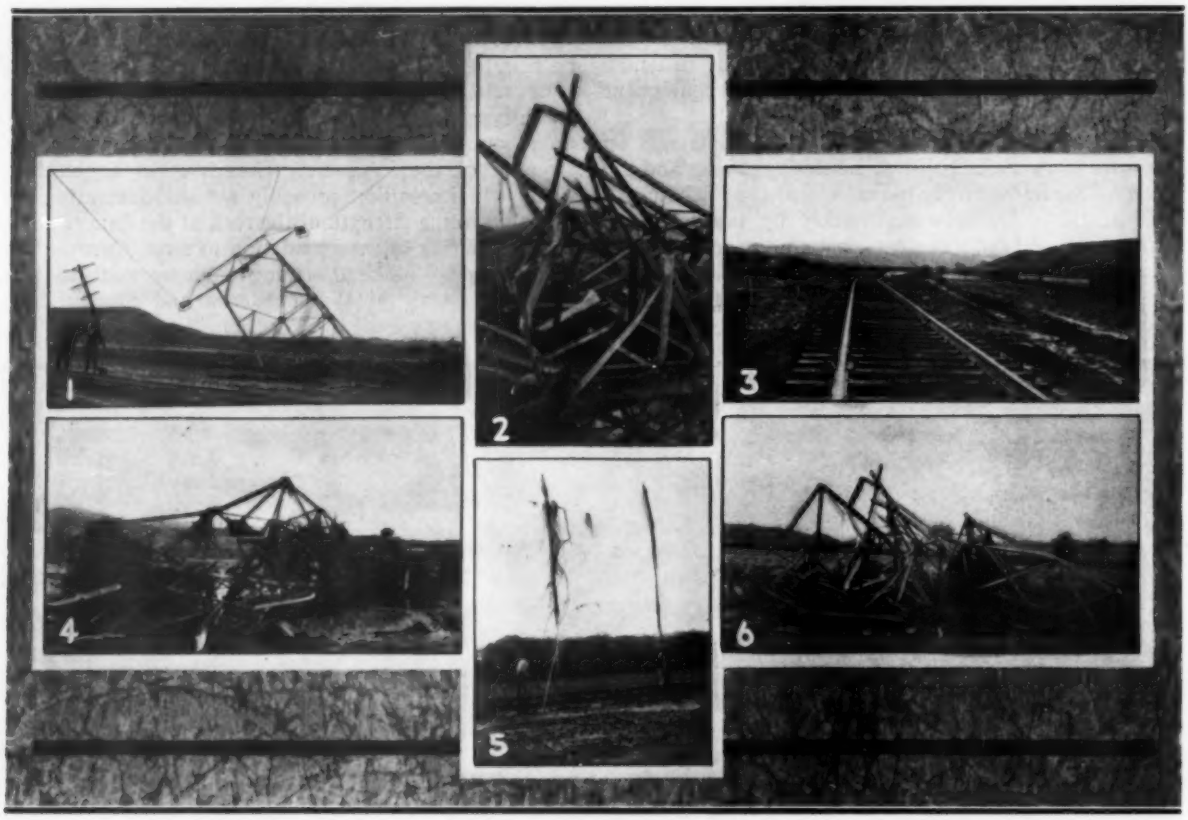
The deepest erosion at the site of the dam was on the west slope about half-way between the base and the crest. This undoubtedly indicates that the initial break was at this point followed quickly by failure of the base of the section. The east section did not fail until a considerable portion of the reservoir had drained, as there is little erosion in the upper portion of the easterly section.

EFFECT OF FAILURE ON CONSTRUCTION

There has been nothing in the failure of the St. Francis dam to indicate that the gravity type of construction is not reliable. Early reports referred to this dam as an "arch-type" dam. It was built with a curved face, but no reliance was placed on the arch as adding to the strength of the structure. Consensus of engineering opinion indicates that probably not sufficient attention was paid to the strength of the rock at the dam site nor to the grouting of the foundation to strengthen the entire structure. The designing engineer and the Los Angeles Bureau of Water Works and Supply have always had an excellent reputation.

SCENES 8 MILES BELOW THE ST. FRANCIS DAM TAKEN THE MORNING OF MARCH 13

1. Sand deposit 1/3 mile wide and from 10 to 30 feet deep near Harry Carey Ranch House. 2 and 3. Views upstream showing undercutting of stream bank and flow of Aqueduct water. 4. Two-foot reinforced concrete shoulders washed out from Ridge Route Highway. 5. Debris caught by telephone and telegraph posts. 6. Thirty-inch corrugated iron culvert washed out with concrete head wall intact. 7. Transmission tower damaged by floating carcass. 8. Two-inch galvanized iron fence poles set in concrete bent over by force of flood. ***Photographs by the Editor.***



DAMAGE TO TRANSMISSION TOWERS AND RAILROAD BY ST. FRANCIS FLOOD

1. Tower crumpled by flood waters. 2. Tangled wreckage of tower. 3. Railroad track moved by force of flood. 4. Wreckage showing buckling of compression members of tower. 5. Branches of trees caught in telephone wires showing depth of flood over half-mile from Santa Clara River. 6. Tower wrecked by floating tree trunk. Photographs by the Editor.

Reclamation Work in Areas Flooded by the St. Francis Dam Failure

In extended portions of the San Francisquito Valley and the Valley of the Santa Clara River, both of which were flooded by the breaking of the St. Francis Dam, large areas were submerged to depths of 5 to 20 feet. These areas, being mostly in eddies, received large deposits of tree trunks, portions of demolished houses and other structures, and other floating rubbish. Several portions of the highway leading northwest from Saugus to the famous Ridge Route, were rendered almost impassable by deposits of tree trunks. Near the Southern California Edison Co. Substation, near Saugus, large fields under cultivation were littered with rubbish and had to be cleaned before the work of cultivation could continue.

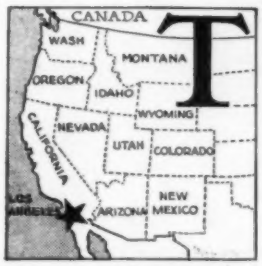
Immediately upon the subsidence of the flood waters after the break of the St. Francis Dam, the Los Angeles County Road Department sent its construction equipment to aid in the reclamation work in the devastated area. The Universal crane unit shown in the accompanying photograph was used to clean sand from the highway which had been submerged under three feet of wet sand following the flood. On the day that W. S. Hunter, Los Angeles representative of the Universal Crane Co. visited the job, the crane cleaned up about 1000 lineal feet of highway in 14 hours, loading approximately 1100 yards of wet sand into trucks. The trucks hauled it about 300 feet up in advance of the crane where the sand was used to fill in a spot where the highway had been completely washed out.

A Universal Crane Cleaning Up Sand and Debris from Highway Submerged Under Three Feet of Wet Sand in the St. Francis Dam Area

Let us be thankful for the fools. But for them the rest of us could not succeed.—MARK TWAIN.

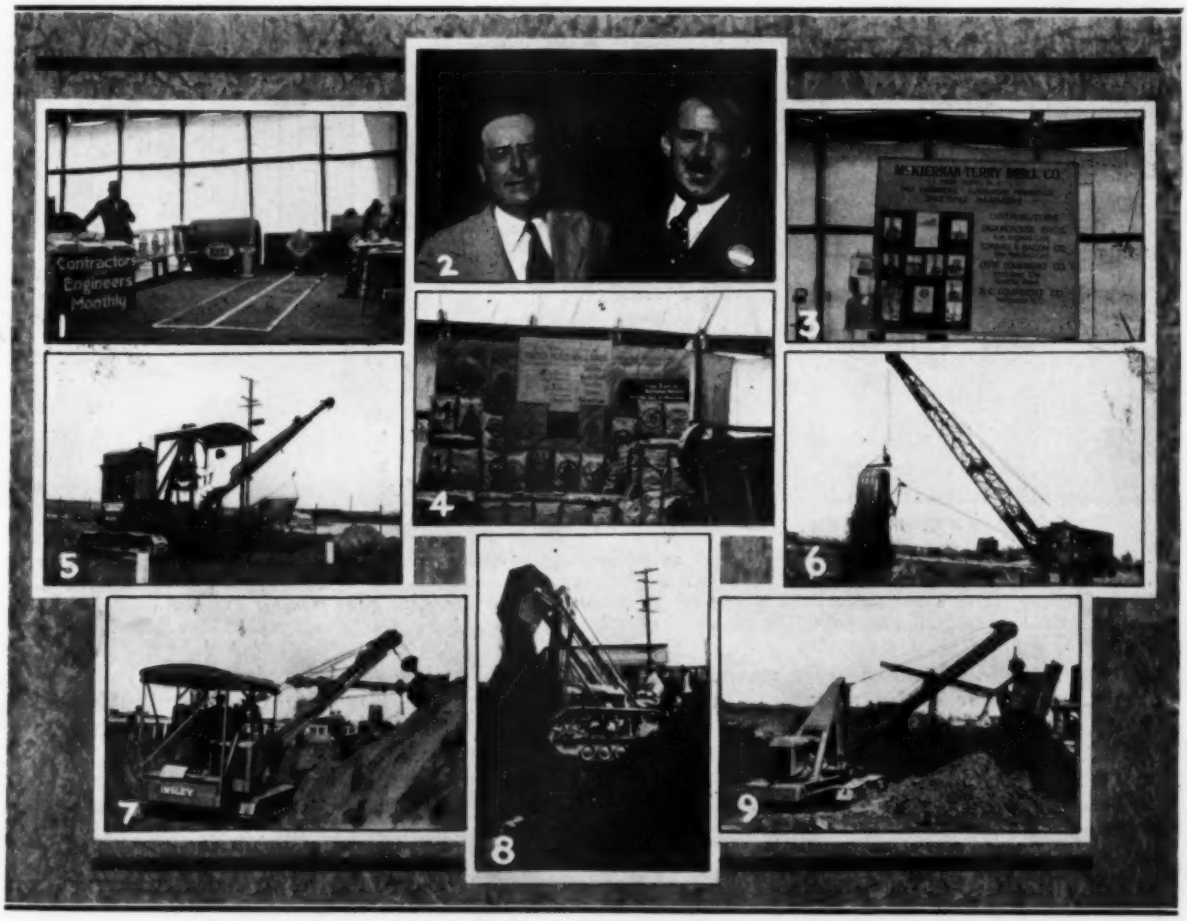
Los Angeles Stages Greatest Open Air Road Show

Western Road and Equipment Exposition Successful



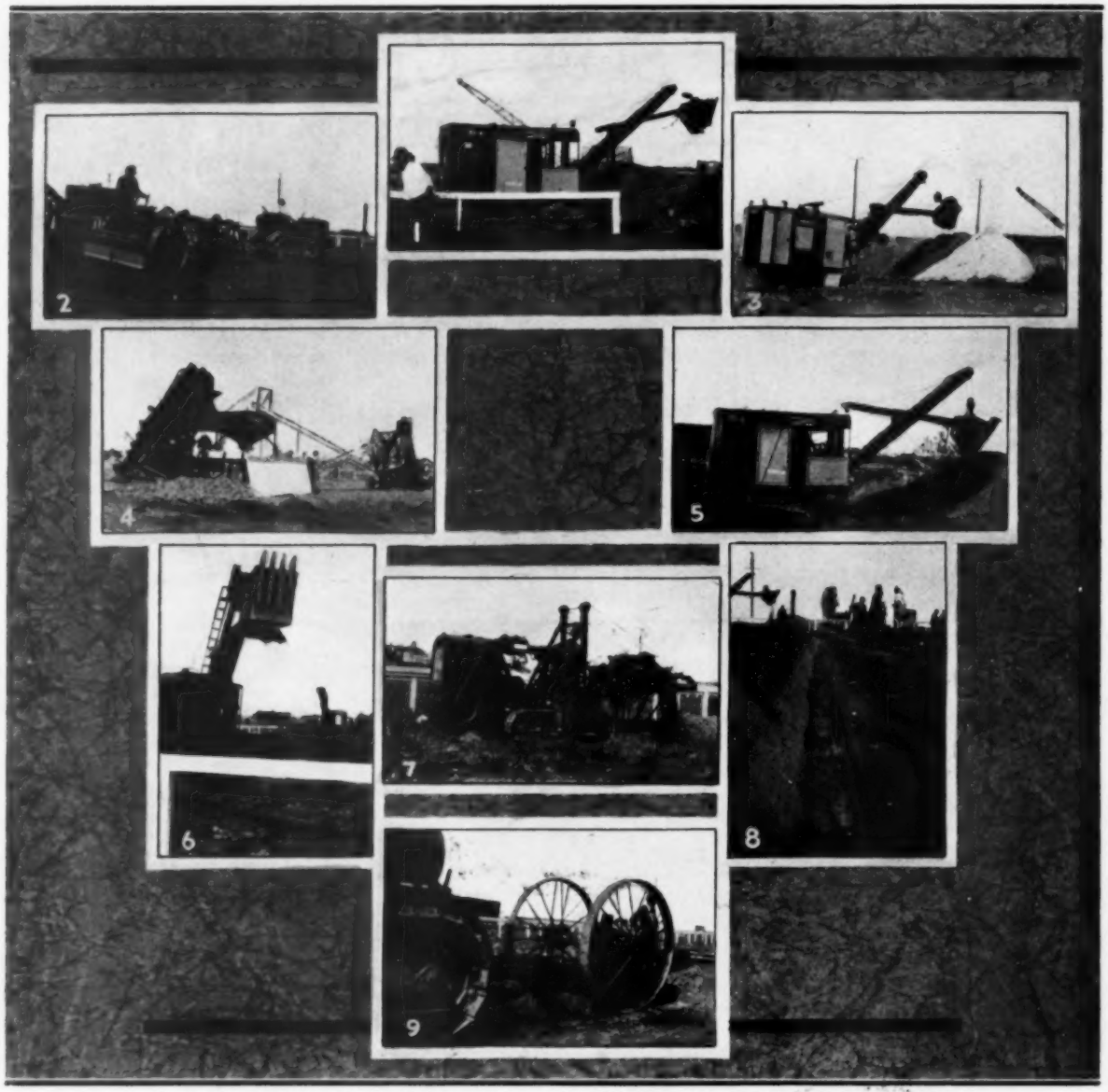
THREE of the largest sized tents and a ten-acre lot were required to take care of the exhibits at the Western Road and Equipment Exposition held in Los Angeles, Calif., March 7-11, 1928. All arrangements from registration to the directing of visitors through the exhibits were handled most efficiently. It was undoubtedly the greatest open-air road show ever held in this country. Edward R. Bacon, President, Edw. R. Bacon Co., well-known San Francisco distributors, and who was responsible in large measure for the two All-Western Road Shows held in San Francisco in 1925 and 1926, has authorized the following statement in CONTRACTORS AND ENGINEERS MONTHLY, "The Western Road and Equipment Exposition held in Los Angeles is the best ever held on the Pacific Coast. Its organizers profited by the experience of the two previous shows in San Francisco. The time of year chosen for the show was better than November as people are in a buying humor. This show resulted in more sales made at the show and more contacts established."

The Exposition was held in the Central Manufacturing District in Vernon, the manufacturing city which is a separate corporation within the city limits of Los Angeles and five miles from the center of Los Angeles. Adequate fire protection was provided by the presence



UNDER CANVAS AND ON THE LOT AT THE LOS ANGELES ROAD SHOW

1. The exhibits of The Morris Engineering Co. and CONTRACTORS AND ENGINEERS MONTHLY. *2. Dan. R. Brown, president, Brown-Bevis Co., and A. B. Todd, Jr., manager, Harron, Rickard & McCone Co., who were largely responsible for the success of the show. 3. The McKiernan-Terry Drill Co. exhibit, planned by Garlinghouse Bros. 4. The Bates Valve Bag Co. exhibit. 5. A P & H backfiller. 6. The Link-Belt dragline in operation. 7. The Insley excavator with bucket attachment digging in. 8. The North Hydraulic Digger on a Trackson Fordson, dumping its load. 9. A Universal power shovel at work.*



SCENES ON THE LOT AT THE WESTERN ROAD AND EQUIPMENT EXPOSITION

1. The Speeder shovel doing its stuff. 2. The Ball wagon grader picking up a load. 3. A Bucyrus-Erie Type-GA-2 shovel. 4. The Iowa one-piece crusher screen and bin, with a Barber-Greene loader. 5. Another view of the Speeder shovel. 6. The Byers-Massillon shovel which claimed the highest lift on the lot. 7. This Cleveland baby trencher dug neat ditches from sunrise to sunset. 8. The type of ditch made by the Killefer trenches shown in 9. Photographs by the Editor.

of two pieces of American-LaFrance equipment housed in a temporary fire station near the entrance to the tents.

WELL MANAGED

Registration was required of all who wished to enter the exposition, although there was no admission fee. Every visitor was required to wear his registration badge with his name prominently written on it. A daily publication carried interesting notes of the show and a complete directory of all exhibits. The three tents were designated as Sections A, B, and C, and contained exhibits numbered from 101 in the first tent or Section A, from 201 in Section B, and from 301 in Section C. Thus it was easy to locate any exhibit desired.

In spite of a deluge two days before the show, the ground was only damp and consequently there was no dust. The sandy soil drained easily, which was fortunate, as no provision had been made to ditch the tents on the outside for drainage. White rails and posts marked the limits of the various exhibits and typical road signs furnished by the Southern California Automobile Association carried the number of the space and the name of the exhibitor.

Notable in this show was the absence of signs featuring the distributor. Rather, the distributor took the attitude that it was the equipment that was allimporant and a sign was usually displayed with the name of the manufacturer and below it the names of the distributors cooperating in the exhibit.

Every variety of construction equipment was shown, as well as several new models that have been brought out since the Cleveland Show in January. Throughout the tents mixers and shovels were operating under their own power with the exhausts carried outside the tents.

Between the first two tents were rest rooms provided for both women and men and between the second and third tents the administration building was situated. Entrance to the show was possible only through the main gate and the demonstration field could be reached only by going through the three tents. A feature of the demonstration field was the dividing off of the various exhibits by white fences that kept those not familiar with the movements of the equipment out of range of booms and buckets.

SPECIAL DAYS

Wednesday, March 7, was Dealers' Day and, under the Chairmanship of Dan R. Brown, the Western Construction Distributors, Inc., held a meeting in the headquarters building of the Central Manufacturing District at 2:30 P. M.

Thursday, March 8, was Contractors' Day and brought out a large attendance of contractors from all the Western states who attended a convention at 10:30 A.M. in the Exposition Auditorium. At 2:30 P.M. the California A. G. C. delegates met under the Chairmanship of Melville Dozier, Jr., who also presided at the morning meeting. The A. G. C. members held a dinner meeting at 6:30 P.M. at the Jonathan Club.

Friday, March 9, was designated as County Supervisors' and Contractors' Day. The County Supervisors' Association of California had a meeting at 10:30 A.M. in the Exposition Auditorium with J. H. Hunter, President, as Chairman. March 9 was also designated as State Highway Officials Day and included a meeting of the Western Association of State Highway Officials with Henry H. Blood, President, as Chairman. An elaborate movie carnival and dinner dance was held at the Mack Sennett Studios from 7 P.M. until 1:30 A.M. A course dinner, elaborate vaudeville acts and a 12-piece dance orchestra provided entertainment for a group of around 700 throughout the evening.

Saturday, March 10, was Engineers' Day, and the convention of the western members of the American Association of Engineers was held at 9:30 A.M. in the Exposition Auditorium with E. Earl Glass, President, Los Angeles Chapter, American Association of Engineers, presiding.

Sunday, March 11, was Operators' Day, and special invitations were sent to operators of shovels, graders, and other construction equipment that on their off-day they might have an opportunity to visit this great exposition.

The attendance throughout the Show was far beyond the fondest hopes of the most enthusiastic California booster. The total registration is reported to have exceeded 20,000.

ELABORATE EXHIBITS

The most elaborate exhibits within the tents were probably the model exhibit of the Union Oil Co. of California which had models showing an oil well, the laying of a pavement in a city and a complete hot mix plant. The exhibit of the California Corrugated Culvert Co. showed the types of drainage handled by corrugated culverts with an elaborate scenic background and gates of various types on the culverts. A flow of water was maintained through the culverts during the show. On the demonstration field the P & H exhibit was probably the largest, consisting of four pieces of excavating equipment. The tents were attractively decorated both inside and out by flags and bunting. Many of the exhibitors added materially to the attractiveness of the tents by the novelty of their exhibits and the use of potted plants, rugs and lounges.

EXHIBITORS

Among the manufacturers exhibiting direct or through distributors were:

Alemite Lubricator Co., Los Angeles; Alloy Steel and Metals Co., Inc., Los Angeles; J. D. Adams & Co., Indianapolis; American Bosch Magneto Corp., Springfield, Mass.; American Manganese Steel Co., Chicago Heights, Ill.; American Saw Mill Machinery Co., Hackettstown, N. J.; Anthony Co., Streater, Ill.; Associated Manufacturers Co., Waterloo, Iowa; Atlas-Imperial Engine Co., Oakland, Calif.; Atlas Scraper Co., Bell, Calif.; Austin Mfg. Co., Chicago, Ill.; Austin Western Road Machy. Co., Chicago, Ill.; Autocar Sales Service, Los Angeles, Calif.

Baker Mfg. Co., Springfield, Ill.; Ball Wagon Grader Co., Los Angeles, Calif.; Barber-Greene Co., Aurora, Ill.; Barnes Mfg. Co., Mansfield, Ohio; Bates Valve Bag Corp., Los Angeles, Calif.; J. E. Bauer, Los Angeles, Calif.; Bay City Dredge Works, Bay City, Mich.; Beach Mfg. Co., Montrose, Pa.; Beebe Bros., Seattle, Wash.; Belle City Mfg. Co., Racine, Wis.; Bitumuls Corp., Los Angeles, Calif.; W. M. Blair Mfg. Co., Chicago, Ill.; Blaw-Knox Co., Pittsburgh, Pa.; Blystone Mfg. Co., Cambridge Springs, Pa.; Brookville Locomotive Co., Brookville, Pa.; Buckeye Traction Ditcher Co., Findlay, Ohio; Bucyrus-Erie Co., Erie, Pa.; Buda Co., Harvey, Ill.; Budd Wheel Service, Los Angeles, Calif.; Buffalo-Springfield Roller Co., Springfield, Ohio; Burch Corp., Crestline, Ohio; Butler Bin Co., Waukesha, Wis.; Byers Machine Co., Ravenna, Ohio.

California Corrugated Culvert Co., West Berkeley, Calif.; Philip Carey Co., Cincinnati, Ohio; Ralph B. Carter Co., New York; Caterpillar Tractor Co., San Leandro, Calif.; C. H. & E. Mfg. Co., Milwaukee, Wis.; Chain Belt Co., Milwaukee, Wis.; Cleveland Tractor Co., Cleveland, Ohio; Cleveland Trencher Co., Euclid, Ohio; Cleveland Wheelbarrow & Mfg. Co., Cleveland, Ohio; Clyde Iron Works, Duluth, Minn.; Concrete Machy. Co., Waterloo, Iowa; Concrete Form-Hold Co., Inc., Culver City, Calif.; Continental Motors Corp., Muskegon, Mich.; The Conveyor Co., Los Angeles, Calif.; Cresson-Morris Co., Philadelphia, Pa.

Denby Motor Truck Co., Los Angeles, Calif.; DeWalt Products Co., Los Angeles, Calif.; Domestic Engine & Pump Co., Shippensburg, Pa.; Dyrr Mfg. Co., Huntington Park, Calif.

Easton Car & Construction Co., Easton, Pa.; Economy Equipment Co., Los Angeles, Calif.; Eisemann Magneto Corp., New York; Elgin Sales Corp., New York; Elliott-Horne Co., Los Angeles, Calif.; Ersted Mfg. Co., Portland, Ore.; E. D. Etnyre & Co, Oregon, Ill.; Everlasting Paint and Sales Co., Los Angeles, Calif.

Fate-Root-Heath Co., Plymouth, Ohio; Federal Motor Truck Co., Detroit, Mich.; Foote Co., Nunda, N. Y.; Ford Motor Co., Los Angeles; Freeman Mfg. Co., Racine, Wis.; A. W. French & Co., Chicago, Ill.; Fuller & Johnson Mfg. Co., Madison, Wis.; Four Wheel Drive Auto Co., Clintonville, Wis.

Galion Iron Works & Mfg. Co., Galion, Ohio; George Gardner, Redlands, Calif.; General Excavator Co., San Francisco, Calif.; General Wheelbarrow Co., Cleveland, Ohio; Gilmore Oil Co., Los Angeles, Calif.; Goulds Pumps, Inc., Seneca Falls, N. Y.; Graham Bros., Los Angeles, Calif.

Geo. Haiss Mfg. Co., New York; Hardsocg Wonder Drill Co., Ottumwa, Iowa; Harnischfeger Corp., Milwaukee, Wis.; Hercules Motor Corp., Canton, Ohio; Heltzel Steel Form & Iron Co., Warren, Ohio; Hughes-Keenan Co., Mansfield, Ohio.

Industrial-Brownhoist Corp., Cleveland, Ohio; Insley Mfg. Co., Indianapolis, Ind.; International Harvester Co., Los Angeles, Calif.; Iowa Mfg. Co., Cedar Rapids, Iowa.

Jaeger Machine Co., Columbus, Ohio; C. S. Johnson Co., Champaign, Ill.

Killefer Mfg. Co., Los Angeles, Calif.; Koehring Co., Milwaukee, Wis.; Kohler Co., Kohler, Wis.; Knickerbocker Co., Jackson, Mich.

Lakewood Engg. Co., Cleveland, Ohio; LaPeer Trailer Corp., LaPeer, Mich.; Leach Co., Oshkosh, Wis.; LeRoi Co., Milwaukee, Wis.; A. Leschen & Sons Rope Co., St. Louis, Mo.; Link-Belt Co., Chicago, Ill.; Littleford Bros., Cincinnati, Ohio.

Madsen Iron Works, Los Angeles, Calif.; Marion Steam Shovel Co., Marion, Ohio; McKiernan-Terry Drill Co., New York; Metaweld, Inc., Philadelphia, Pa.; Monarch Tractors Corp., Springfield, Ill.; Moreland Motor Truck Co., Burbank, Calif.

National Brake & Electric Co., Milwaukee, Wis.; National Lead Co., Cinch Bolt Dept., New York; Northwest Engg. Co., Chicago, Ill.; Novo Engine Co., Lansing, Mich.

Orton Crane & Shovel Co., Chicago, Ill.; Osgood Co., Marion, Ohio; Owen Bucket Co., Cleveland, Ohio.

Pacific Car & Foundry Co., Los Angeles, Calif.; Pacific Clay Products Co., Los Angeles, Calif.; Pan American Petroleum Corp., Los Angeles, Calif.; Parsons Co., Newton, Iowa; Pierce Governor Co., Anderson, Ind.; Portland Cement Association, Chicago, Ill.

Ransome Concrete Machinery Co., Dunellen, N. J.; Rapid Pavement Breaker Corp., Los Angeles, Calif.; Reo Motor Truck Co., Lansing, Mich.; Republic Truck Sales Corp., Alma, Mich.; W. A. Riddell Co., Bucyrus, Ohio; Russell Grader Mfg. Co., Minneapolis, Minn.

Saline Products, Inc., Los Angeles, Calif.; Sauger Derrick Co., Chicago, Ill.; Sauerman Bros., Chicago, Ill.; Schramm, Inc., West Chester, Pa.; Sidney Steel Scraper Co., Sidney, Ohio; T. L. Smith Co., Milwaukee, Wis.; Smith Engg. Works, Milwaukee, Wis.; Spears-Wells Machy. Co., Oakland, Calif.; Speeder Machy Corp., Cedar Rapids, Iowa; Standard Oil Co. of Calif., Los Angeles, Calif; Standard Auto Body Works, Los Angeles, Calif.; Stover Mfg. & Engine Co., Freeport, Ill.; Stockland Road Machy. Co., Minneapolis, Minn.; Stoody Co., Whittier, Calif.; Sullivan Machy. Co., Chicago, Ill.; Superior Culvert & Flume Mfg. Co., Los Angeles, Calif.; Symons Bros., Los Angeles, Calif.

Thew Shovel Co., Lorain, Ohio; Tousley Tool Co., Cleveland, Ohio;

Trackson Co., Milwaukee, Wis.; Truck & Trailer Equipment Corp., Los Angeles, Calif.; Truscon Steel Co., Los Angeles, Calif.
Union Iron Works, Hoboken, N. J.; Union Oil Co., of Calif., Los Angeles, Calif.; Universal Power Shovel Co., Highland Park, Mich.
Wallis Tractor Sales Corp., Los Angeles, Calif.; Webr Co., Milwaukee, Wis.; Western Asphalt Assoc., Los Angeles, Calif.; Western Machinery Co., Los Angeles, Calif.; Geo. D. Whitcomb Co., Rochelle, Ill.; Whitehead & Kales Co., Detroit, Mich.; G. H. Williams Co., Erie, Pa.; Wilson Welder & Metals Co., Hoboken, N. J.; W-K-M Co., Houston, Texas; Wood Hydraulic Hoist & Body Co., Los Angeles, Calif.; Worth Machy. Mfrs., Los Angeles, Calif.

DISTRIBUTORS

Edw. R. Bacon Co., San Francisco; Brown-Bevis Co., Inc., Los Angeles; Collins-Kay Machy. Co., Los Angeles; Concrete Machy. & Supply Co., Los Angeles; Construction Machy. Co. of Calif., Los Angeles; Norris K. Davis, San Francisco; Essick & Co., Los Angeles; Garlinghouse Bros., Los Angeles; Harron, Rickard & McCone Co., Los Angeles and San Francisco; Lambert Sales Co., Los Angeles; Leitch & Co., San Francisco; Master Equipment Co., Los Angeles; Leigh M. Railsback, Los Angeles; Red Motor Car Co., Los Angeles; Smith Booth Usher, Los Angeles and San Francisco; Warren & Bailey Co., Los Angeles.

The Appian Way Outside of Rome Showing the Gravel Surface

A History of Highways

By John S. Worley

Dept. of Transportation, University of Michigan

THE stones for the first Egyptian pyramid, constructed during the IV dynasty (2,800 B. C. Breasted,—5,000 B. C. Petrio) were brought from the Arabian mountains to the Nile, thence by water to within a short distance of the site of the pyramid. From here the large blocks of stone were transported over a causeway for the construction of which, according to Beloe's Herodotus, "Ten years were consumed in hard labor of forming the road, through which these stones were to be drawn; a work, in my estimation, of no less fatigue and difficulty than the pyramid itself. This causeway was five stadia (3000 feet) in length, forty cubits (20 feet) wide, and its extreme height thirty-two cubits (16 feet), the whole is of polished marble, adorned with figures of animals."

Pococke, who traveled in Egypt the first half of the 18th Century, found "at this time there is a causeway from that part, extending about 1000 yards in length, and twenty feet wide, built of hewn stone. The length of it agreeing so well with the account of Herodotus, is a strong confirmation that this causeway has been kept up ever since, though some of the materials of it may have been changed, all being now built with free-stone. It is strengthened on each side with semicircular buttresses, about fourteen feet in diameter, and thirty feet apart; there are sixty-one of these buttresses, beginning from the north. Sixty feet farther it turns to the west for a little way, then there is a bridge of twelve arches, twenty feet wide, built on piers that are ten feet wide. About one hundred yards farther there is such another bridge, beyond which the causeway continues about one hundred yards to the south."

The oldest artificial road extant is one in Cnossos, Crete. "The Palace of Cnossos was approached from the west by a paved Minoan Way communicating with a considerable building on the opposite hill." This road was constructed prior to 1500 B. C. Today it is intact, having a surface of paving stones which is sufficiently smooth for the satisfactory operation of a modern motor car. It has much of the appearance of a modern road. The roadway is about ten feet in width. Unforunately, as far as I have been able to ascertain, no cross section of the roadbed has been taken or a study made of the construction details.

The construction of the great system of Roman roads began sometime about 400 B. C. and continued for 600 years, until by 200 A. D. there were 70,000 miles of improved roads. There were twenty-nine great military highways which radiated from Rome in every direction, comprising a total of 48,500 miles. Every province of the Roman Empire was connected with the capitol by one of these main roads, and in addition there were many secondary roads for local use. While these roads were termed military roads their principal use was that of commerce.

"In the low and level grounds these Roman roads were elevated to a considerable height above the adjoining lands and afforded an extensive view of the surrounding country." The roadway ranged in width from 16 to 30 feet with a depth of 3 to 4 feet, and laid in 3 or 4 courses. The top soil was removed, two or three feet in depth, until a firm foundation was reached; and in case of soft ground all the soft material was removed and replaced by firm material or piling and grillage of brush, timber and such was used so as to obtain a firm foundation. The first or bottom section, the statumen, was composed of two courses of flat stones laid dry or in lime mortar. The depth average 16 to 18 inches. The second course, the rubus, was composed of broken stone mixed with lime in the proportion of 1 part lime to 3 parts stone. This course ranged from 6 to 9 inches deep. Section three, the nucleus, was composed of coarse gravel and lime used hot, or bricks of broken tile mixed with lime and covered with a thin layer of lime mortar. The top or surface of the road, the summa crusta, or pavementum, was constructed of smooth surface polyg-o-nal blocks of granite or hard lava joined so that scarcely any seam or crack showed. This course was 6 inches thick. Each edge of the paved surface was provided with a curb of stone 2 feet wide and 18 inches high. Sometimes, a narrow side road 6 to 8 feet wide flanked the main pavements. These are the approximate dimensions and construction features of the Appian Way.

The Appian Way Showing the Surface Paved with Large Stones

ACKNOWLEDGMENT.—From a paper read at the 14th Annual Conference on Highway Engineering, at the University of Michigan.

The future progress of the accident prevention movement, the decision whether it shall advance with sufficient speed and strength to reduce the apparent increase of accidents in construction for which mass production and mechanical methods are largely responsible, rests with the general contractors of the United States.

Welding—Methods and Uses—II

Structural Pipe and Industrial Welding Discussed by Manufacturers and Users at Boston Meeting

ABSTRACTS of papers presented before a recent meeting held under the auspices of the Affiliated Technical Societies of Boston, in Boston, Mass., were printed in the March issue of CONTRACTORS AND ENGINEERS MONTHLY. In this issue we are printing resumés of three additional papers, because of the many ways in which welding is entering into the construction field, and because of the increased desire on the part of the contractors to learn more about methods of welding and their results.

What Research Reveals in Welding Wire

By C. A. McCune

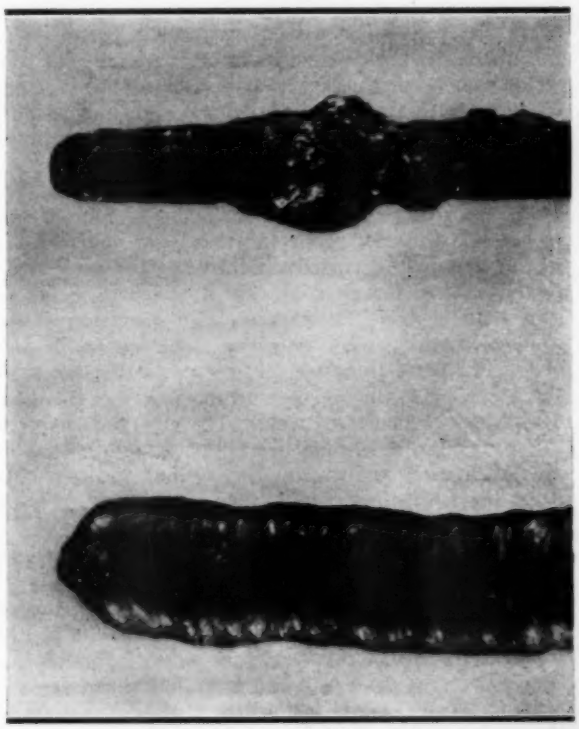
Director of Research, American Chain Co., Bridgeport, Conn.

Some time ago an effort was made to determine what constituted an unsatisfactory welding wire as well as a satisfactory one. About twenty groups of wires were secured from various sources, these wires being submitted with the statement that good welds could not be secured with them. Hundreds of specimens taken from these wires were examined for chemical analysis, physical properties, micostructure and weldability. In some cases the chemical analyses showed the material to be what could be considered a very good grade of metal and in other cases a quite average grade. The carbon content ran from 0.02 to 0.20. The tensile strength varied from 40,000 to 100,000 pounds per square inch. The elongation varied from 2 to 30 per cent for material intended for the same purpose. The microscope revealed structures that were all over the map from very well annealed to hard drawn and from clean to very dirty metal. The weldability tests bore out the fact that these metals were unsatisfactory for welding purposes.

For some years we have been using what has been termed the flame test, which consists simply in melting down the surface of the wire with a small oxy-acetylene flame, making it possible to see some of the things that were causing imperfect welds. Illustrations thrown on the screen showed the results obtained by the flame test, indicating that the metal in unsuitable wire boiled with a disturbing action when melted and the metal in satisfactory wire melted quietly and smoothly without any evidence of gases or other inclusions. It was demonstrated that it was possible with defective welding wire to make what appeared to the eyes to be a satisfactory weld. That is, there were no indications on the surface that the weld was other than a satisfactory one. When the weld was cut in two the defects that were apparent in the wire, as developed by the flame test, were embodied in the weld.

WHAT IS A SATISFACTORY WELDING WIRE?

A satisfactory welding wire must be free from excessive impurities, such as gases, slag, etc., and for electric welding a special added requirement is that the structure be such that the arc will be properly directed. It is difficult to specify such requirements. The only attempt made now to cover welding wire by specification is to limit carbon, manganeses, phosphorus, sulphur and silicon. Experience shows that this is not sufficient. It is necessary to add other requirements but just what these are has not been thoroughly defined. The flame test could be included as it is easily and



Flame Test on Welding Rods

rapidly made and gives a clear indication of what might be expected in the use of the material.

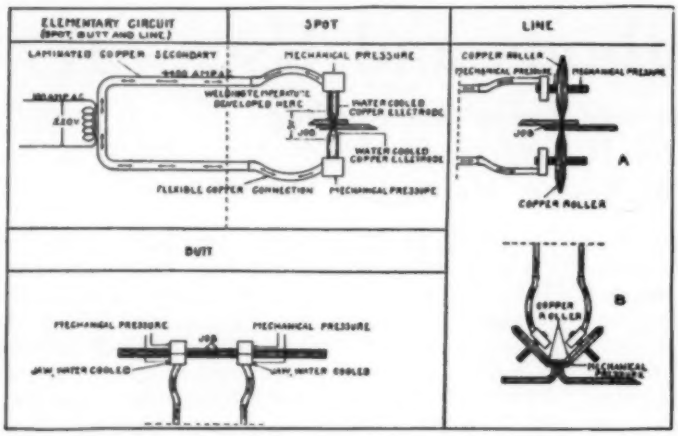
The so-called flame test can also be produced by an electric welder by freezing the electrode to the base metal and holding it there until it reaches the melting point. The same characteristics will be observed by this method as in the flame test.

Application of Projection and Multiple Welds

By W. T. Ober

Thomson Electric Welding Co., Lynn, Mass.

Electrical resistance welding is divided into spot welding, generally thought of in connection with the



Two Applications of Seam or Line Electric Arc Welding

joining of overlapping sheet metal parts; butt welding in bringing parts end to end or edge to edge; and seam welding, which is practically a continuous spot weld along the overlapping edges of sheet metal parts. Since the discovery of resistance welding practically all spot welds have been made by using a spot welding machine equipped with two so-called pointed copper electrodes or welding dies, the actual size of the point depending upon the thickness of the metal to be welded, the capacity of the welding machine used, the size of the spot weld required, etc. In this method, the pointed electrodes serve as the agents for localizing and concentrating the flow of current to the mass of material directly between the electrodes, and, of course, only one spot weld is made for each cycle of operation of the welding machine. By punching a projection on one of the two parts to be welded, the projection serves as the agent for localizing the current flow and therefore determines the point of weld. The size and shape of this projection determine to a great extent the size or area of the weld and thus the strength of the weld. By using this projection it is no longer necessary to use a pointed electrode, which wears away fairly rapidly, but rather large, flat-ended electrodes can be used, which last almost indefinitely.

As the demand for increased production of welded parts grew, experiments were made to determine the possibility of making several spot welds in one operation. This was done by using large flat electrodes and welding together parts which had a number of projections. It requires a welding machine of larger electrical and mechanical capacity to make several welds in one operation than is required for making single welds.

Within the last three or four years the Thomson Co. has designed and developed a number of more or less special welding machines to be used particularly for making multiple projection welds. There have also been developed machines for making multiple welds on parts, the inherent shape or form of which is such that the parts themselves supply their own projections. A typical illustration of this is the welding in one cycle operation of a number of wires to one or more wires which cross at right angles as in refrigerator shelves, stove oven racks and fencing. Another application of this form of welding is in the manufacture of grating made from a series of flat rectangular bars stood on edge, to each bar of which is welded in one operation a round or twisted bar laid at right angles to the longitudinal axis of the strip.

The Atomic Hydrogen Welding Process

By P. Alexander

Thomson Research Laboratory, West Lynn, Mass.

As a welding tool, the atomic hydrogen torch must be compared with the oxy-acetylene torch. It has similar characteristics in that most of the energy is produced in a comparatively small inner cone or fan where extremely high temperature is attained. This inner hot zone is surrounded by the flaming or reducing gas with temperatures gradually falling of to that of the outer mantle of the flame where the recombined molecular hydrogen is burned in contact with the air. The temperature of that part of the flame is something like 1000 degrees Centigrade. This gradual change of temperature gives an extreme flexibility in the atomic hydrogen torch. It insures a perfect control of speed of welding and of the temperature of the molten metal in the weld. This last factor is of paramount importance for welding in hydrogen atmospheres. This gas is only slightly soluble in molten iron just above the melting point, but with a rise of temperature its solubility increases very rapidly. When the molten metal is overheated it will absorb at least 15 times its own volume of gas measured at normal temperature and pressure. During the solidification most of that gas will be precipitated out and unless special precautions are taken will form numerous blow holes.

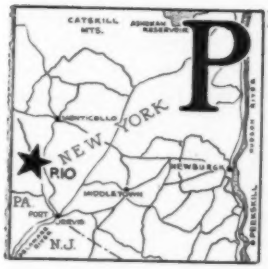
If the welder, however, follows the right technique by forming only a shallow pool of molten metal, which insures a low temperature of the molten metal, hydrogen will be prevented from going into solution and the resulting weld will be perfectly free from gas pockets.

The alternating current arcs used in the atomic hydrogen process are usually two or three centimeters in length, bent in the shape of a fan between two tungsten electrodes, shaped to form a V. The voltage drops at the surface of the electrodes which correspond to anode and cathode in direct current arcs, are equal to about 18 volts each.

There was a time when no one dreamed of using anything but pure wrought iron. Then there came an age of iron carbon alloys, that is, of steel, and now we are entering the era of alloy steels. Most of those steels contain such easily oxidizable elements as chromium and unless the weld is protected by a reducing atmosphere the results of welding such materials are not satisfactory. It is in this field that the new processes probably will find their best application. The electric arc and the gas flame will in the future replace the rivet cutting tool and the foundry molds. Amongst innumerable fields of applicants, there will be a demand for every kind of welding and cutting processes. The described process will not replace any of the existing processes but simply assume its place of usefulness among the older brothers and do the job which cannot be done without its help.

From Game Preserve to Water Power Development

By Leo D. Woedtke
Fred T. Ley & Co., Inc., Springfield, Mass.



PRIVATE game preserves, with wonderful lakes, streams and animal life, nestling at the foot of the Catskill Range were involved in the construction of the Rio Dam near Port Jervis, N. Y. Some idea of the primitive conditions found when the work was started is gained from an incident wherein the workmen, who carried their lunches from the Commissary to distant points, while clearing brush, found at noon time that the deer had come in and stolen their lunches. The job is located in the heart of a very wild country, thirteen miles from the nearest town or railroad station, Port Jervis, N. Y., and it was necessary to take care of the workmen in a temporary construction camp.

Construction Camp

The men were brought into the camp and taken care of, with necessary housing quarters and facilities for serving meals. This entire operation was handled by the contractor, Fred T. Ley & Co., Inc., instead of letting out the housing and commissary to concerns which do this kind of work. The contractor found that by running the Commissary, while it was not expected to make any money on the operation, he was able to give the men better food, better living conditions and increase the moral attitude and efficiency of the men as well as decrease the labor turnover. The camp averaged about one hundred and fifty men.

To prepare for the flooding of the reservoir area, it was necessary to clear 1000 acres of timber and brush to impound 6,000,000 gallons of water. The Rockland Light & Power Co. maintains a large force of foresters and loggers in and about its property, which covers about 20,000 acres, mostly heavily wooded. These men did the clearing of the basin. The material for form work was all felled and cut by these foresters.

Gravel Pit Upstream from Dam Site Which Was the Source of all Aggregate for the Dam

The water backed up by the dam will extend for three miles upstream and will flood out the county road and two bridges. The county road is to be relocated to run on a bridge across the top of the dam.

Materials

Cement for this job was carried over 13 miles of road from the nearest railroad station to the site of the work. One and one-half miles of this road were built from the state highway into the actual operations, over almost virgin mountain country. Gravel and sand were obtained about 2,000 feet from the site of the work along the river bed. A ¾-yard Erie steam shovel was used in the gravel pit and loaded this material into 1-yard Dodge dump trucks, which conveyed the material to the crushing plant.

Sand and Gravel Plant

On arrival at the crushing plant, the gravel and sand were dumped on grizzlies, the smaller material going through the grizzly and the larger material being thrown off into the crusher, where it was crushed into various sizes for the work. This was in turn conveyed to the screen. All material was thoroughly washed before being used, by means of a Telsmith scuffer and washer. Then it was dumped into bins which held about 2,500 tons of material.

In measuring the materials for concrete, the contractor used the Blaw-Knox proportioning plant of the inundation type, wherein he was able to determine exactly the proportion used, this giving an assurance of absolute accuracy as to the aggregates of the concrete, and a uniformity of material throughout the dam was absolutely assured.

From the bins, by gravity, the material was conveyed into two 1-yard Smith mixers capable of turning out 500 cubic yards of concrete per day. From the mixers

Box Crib Which Diverted the Stream During Construction

Earth Embankment at End of Rio Dam Showing Sluicing Operations. In the Background Are the Administration Offices and Bunkhouse

the material was sent to the dam by industrial railroad and derricks equipped with scale pans which lifted it to the forms.

STREAM FLOW DIVERTED

There was such an amount of water in the stream that it was necessary to build a wooden box crib cofferdam to divert the water from one side of the stream, while that portion of the dam was being installed. On completion of that section, the water was diverted to the other side while the dam was completed. After the bottom portion of the dam had been constructed, a temporary sluiceway, which was later sealed, was made to carry off the water in case of high flood.

EMBANKMENT

It was necessary to use some 3,000 cubic yards of earth embankment at the ends of the concrete spillway. This was done by a so-called semi-hydraulic method, wherein the material was carted on to the sides of the slopes and from there was conveyed to the center of the dam, by playing a hydraulic gun on the materials as they were dumped from the cars.

This formed a pool in the center between the two embankments, the heavier materials being deposited as the water flowed to the center, and the finer materials staying in suspension until they reached a quiet pool in the center. The finer materials, which are essential for a tight core in the center of the dam, then settled directly over the core of the dam, leaving a graded embankment from the coarse material on the outside to the fine material in the center of the dam.

The upstream faces of these embankments were then riprapped with heavy stone, so that the water will not erode the surfaces when the wind whips the reservoir into waves.

TRANSCONTINENTAL OIL LINE ENCOUNTERED

A series of five pipe lines used for transporting oil from the Pennsylvania fields to the northern market through which this oil was pumped, ran through the area flooded. This made it necessary to raise them over the reservoir on a combination wood and steel trestle.

The equipment used in connection with the work consisted of two 100-foot steel derricks and concrete distributing apparatus including troughs, a scale pan, narrow gage railroad, bottom dump cars, etc. Two ¾-yard and one 1¼-yard Northwest gas crawler shovels were used in the excavation at the site of the dam, and one ¾-yard Erie steam shovel on wheels was used in the gravel pit.

PENSTOCK

The dam contains about 50,000 cubic yards of concrete. It is approximately 105 feet high with a spillway of about 1,200 feet. The water is conveyed from the dam through 7,000 lineal feet of 11-foot diameter red wood penstock. The penstock looks like a big snake going down over the mountain.

FORM WORK AND FINISH

As the spillway section of the dam is built on the arc of a circle, considerable care was necessary to keep the form work true to line. The concrete of the spillway section was poured in 10-foot lifts; and as there was a constant batter on the face of the dam, there was a definite radius for each elevation on the face. The form work was, therefore, shaped by erecting at the required elevation a template sawed out to its corresponding radius and plumbed over an arc of the same radius run out by the engineer. Ribs were then laid from this template to the last template below on radial lines and faced with 1¼-inch pine planking planed on both sides.

This left a smooth surface to the concrete and the only finish necessary for the main structure was to cut off the form wires and knock off the protruding fins.

The bridge balustrade and gate house were brought to a finer finish by rubbing in a neat cement wash with carborundum blocks.

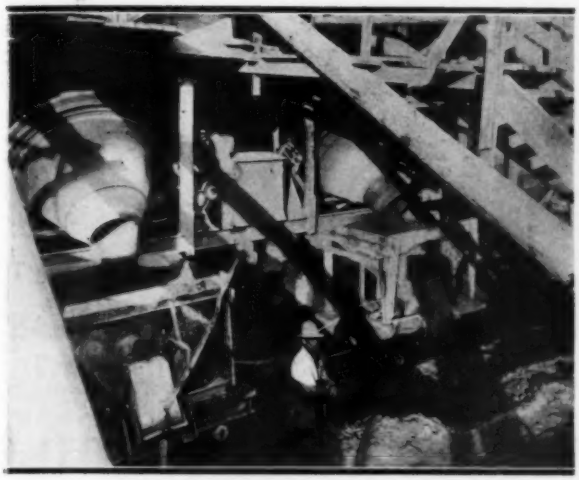
WATERPROOFING

The upstream face of the dam and gate house below the pond level were painted with two coats of Inertol to seal the pores of the concrete and prevent the absorption of water.

BRIDGE SHORING FOR HEAVY HAULAGE

The spillway section of the dam is crossed by a concrete bridge and roadway 15 feet above the spillway crest supported upon piers located on 34-foot centers along the top. This was the only road by which the heavy power house machinery could be transported to

Layout of Concrete Handling Plant at Rio Dam During Height of Operations



The Concrete Mixing Plant Which Produced All of the Concrete for the Rio Dam Job

the power house site. Among the heavier pieces were the three transformers, the rotors of the water wheels and the massive rotors of the generators, the last of which with the trailer and the blocking necessary to hold them securely in place were calculated to weigh 40 tons each.

As 40 tons was more than a prudent load limit for the bridge slabs, the span was halved by setting a line of 8 x 8-inch posts along the center line of the bridge between the spillway top and the bottom of the roadway slabs. These were placed on 2-foot centers and securely wedged between a continuous 8 x 8-inch cap under the

Temporary Sluiceway of the Rio Dam to Care for Flood Waters

bridge floor and foot blocks along the top of the spillway. With this precaution the heaviest loads were passed without the slightest evidence of damage or dangerous deflection.

CONTRACTORS AND ENGINEERS

The work was handled by the Charles H. Tenney Co. engineering forces, of which Frank C. Sargent is Chief Engineer, he being directly in charge and responsible for the operation. Associated with him was Charles T. Main, represented by W. F. Uhl. Angelo Morris was Superintendent in charge of construction for the Ley organization.

This operation is one of a series which have been conceived in the minds of the Charles H. Tenney Co. engineers to harness the stream. This completes the third operation on this same stream, and the same engineering and construction organizations are now starting a fourth operation which may be described at some future time. The fourth operation, like the second, is a 100 per cent hydraulic sluicing operation, the second and fourth dams being entirely of earth.

Starting to Haul a Generator Armature Over the Rio Dam by Using a Crawler Shovel, Motor Truck and Trailer

Surface-Treating an Arkansas Highway

THE Lonoke-Little Rock Highway in Arkansas is part of the main route between Little Rock and Memphis, Tenn. It was found advisable at the beginning of the present year to smooth up the road and to do half the width at a time, so that traffic, which is heavy, would not be subjected to the inconvenience and loss of time resulting from the necessity of making detours.

Two applications of a heavy asphaltic material, Texaco special macadam binder, were specified, each application to be covered with Joplin chats. Before putting on the first application, the old surface was carefully inspected and all pot holes were filled with chats and the asphaltic oil, so that a fairly smooth surface was obtained. The first treatment of binder was then applied at the rate of 4/10-gallon to the square yard, and over this Joplin chats were spread, 40 pounds being required to the square yard. A 10-ton roller went over the surface and secured a thorough bond between binder and chats.

When a few miles of the road had received the initial application of 4/10-gallon of oil, the second application of 3/10-gallon to the square yard was begun. The amount of covering used for this treatment was 30 pounds of chats to the square yard. Then the 10-ton roller was again employed and the entire surface thoroughly bonded.

Under the heavy traffic which uses the Little Rock-Lonoke Road in Arkansas, a surface of this type is capable of giving three or four years' service, when another similar treatment becomes necessary.

Dirt's Moving

A Lorain-75 Power Shovel with Crawler Tread Loading Trains of Watson Wagons Hauled by Caterpillar Thirty Tractors on the Maumee-Parkersburg Bridge Project at Maumee, Ohio

The Highway and Clear Fork River Near Highcliff, Tenn.

The N. C.-Ky. Connection in Tenn.

By N. W. Dougherty

Professor of Civil Engineering, University of Tennessee

ROUTE 9 is a primary connection on the Tennessee State Highway system justifying heavy work in grading and drainage. The average cost throughout Tennessee for this work is approximately $10,000 per mile, while the average cost on 23 miles of this work was more than $26,000 per mile.

The heaviest single piece of construction in the State is in progress on Route 9, in Campbell County, Tennessee. The location extends from LaFollette on the south to Jellico on the north, through a very rugged gorge, and over a territory far from the old road. Over a part of the work out of Jellico, the old county location was followed, giving partial ingress, but from near Morley to a few miles from LaFollette the location is over ground that has never been scratched for a highway.

Quantities

The task is one that must be accomplished under difficulties, and is one that is much larger than the average grading and drainage project of the State. The distance is divided into three sections for convenience of supervision and inspection. One section of 4.71 miles was awarded to one contractor and the other two sections comprising 18.01 miles were awarded to a second contractor. The quantities of material to be moved and the supplies to be furnished make the job an outstanding piece of construction. The excavation consists of 356,293 cubic yards of solid rock and 335,688 cubic yards of common excavation. The drainage consists of 2,350 linear feet of 18-inch pipe, 2,275 linear feet of 24-inch pipe, and 5,000 cubic yards of concrete in the larger culverts, abutments, and bridges. Reinforcing steel will be used to the amount of 620,000 pounds, or 310 tons. The contract price for the 22.72 miles is $590,454.

Drainage

The progress of a grading and drainage project is usually determined by the progress made on the culverts and other drainage structures. The fills cannot be carried forward until the culverts are constructed. To avoid delay, pipe, wherever possible, has been substituted for concrete box culverts. A steam shovel was used for the excavation. The reason for this was twofold; the first being that the shovel was available and could be spared from another part of the work for which it was brought on the job; the second being that the distances between structures was not excessively great. It is doubtful whether the contractor saved money by using the shovel, but it is probable that the cost was not greater than it would have been by hand digging. Labor in this area is not very plentiful since it is a coal mining territory and most laborers prefer the mines to the hot summer sun.

A real problem arose in connection with one of the larger concrete box culverts. One of the largest of the box culverts was located in one of the most inaccessible places on the project. The railway siding was four miles away and there was no road. To go forward with the fill the culvert must be constructed, but to build the culvert the road should be brought to grade. The solution was the storage of materials on the subgrade as close as possible to the site and the construction of a temporary road to deliver materials to the site. The road was constructed and the culvert completed.

Drainage is the key to construction progress. If the culvert man cannot keep out of the way he delays the roadway excavation. Where box culverts were constructed they looked like chimneys, or flues, they were so long and on such steep grades. The accompanying picture shows a culvert constructed on a 37 per cent grade.

Retaining Walls

Practically the whole of the work is on side hill location, and in many places the slope is so steep that the fill will not catch until it reaches the railroad below. This has caused the construction of retaining walls on the down-hill side of the right of way as illustrated. The walls are built of stone quarried near each site, and oftentimes the quarrying was accomplished with con-

siderable difficulty. If a boulder should start to roll it would fall to the railroad or into the stream below. The danger of accident by rolling against a train has been carefully guarded against and to date the operators have been successful in their safety measures. The stone is moved from the quarry and placed in the wall by small portable derricks which are able to lift pieces up to a half-ton.

SOLID ROCK EXCAVATION

Moving 360,000 cubic yards of solid rock is no small task. Throughout the length of the work it is a job for machinery, and at most of the sections for heavy machinery.

Ordinarily, holes for dynamite and powder may be driven by compressed air hammers and churn drills, but here the holes are too deep to be economically driven in this way. As a consequence, three well-diggers were placed on the job and were used in the larger cuts.

Much of the shooting has been done in side-hill cuts where the stone was loosened from the solid to be moved into the fills by steam shovels. Many of the cuts deserve special mention but one will illustrate the type of work. One shot was fired using 15,000 pounds of dynamite to move 15,000 cubic yards of rock. Four holes were drilled at each cross-section, two at the ditch lines and two between the ditch lines and the center of the road. All holes were drilled to grade. The loading was done by the contractor with the advice of a representative of the company furnishing the explosives. The results of the shot were probably as good as could be expected, though hardly as good as the contractor desired. Practically no material was wasted. A few

ROAD CONSTRUCTION SCENES IN TENNESSEE

1. *What* 15,000 *pounds of dynamite will do to a rock ledge.* 2. *Breaking the boulders with air drills and dynamite.* 3. *Bucyrus* 50-*B shovel digging into the mountain.* 4. *A small culvert on a* 37 *per cent grade showing lugs cast in the top to hold earth and rock fill.* 5. *Retaining wall constructed to keep the fill from sliding onto a railroad.* 6. *View behind the retaining wall showing method of setting stone blocks.*

cubic yards of small stone were thrown from the cut but counting the size of the charge there was practically no waste. When the shovel got into the cut it ran into boulders near the grade line that had to be broken before they could be handled. The rock on top of the pile was well broken, and had the holes been somewhat deeper the results would have been better.

MOVING ROCK BY POWER SHOVEL

The moving of material is by steam shovel. The virgin territory is only partially served by a road, and over much of the right of way the ground was so rough that a large shovel could not be moved. To make a path for the larger shovels two small shovels went ahead blazing a trail and path over which the larger shovels were moved to their places on the job. At one point the right of way was so rugged that the small shovel had difficulty in cutting a trail, and to save time the large shovel was moved three miles across a mountain to bring it to the work as soon as possible.

There are three of the three-quarter yard shovels on the work, two of which were used to build roads for the larger shovels, and later used for the lighter excavation. One light shovel was used for excavating sites for culverts. Ordinarily, such a task would be of doubtful economy because of the small quantities involved and because of the large amount of moving. Here the shovel was very useful because of the saving of time and because of its presence on the job for another task it was to perform later in the work. Since it was already at hand its use was probably more economical than lighter tools.

For moving the major quantities of both earth and solid rock, the larger shovels were more satisfactory. They do not require that the stone be broken to such small pieces, and in addition the same operating crew can handle the large shovel as well as the small one. The investment in the larger unit is greater but the material moved per man on the job makes for greater economy. The greatest usefulness of the small shovels was their work in building roadways for their larger brethren.

During the summer ten shovels were on the job and when three more were added all were of the 1¼-yard size. There was a shovel to each two miles of work, which makes the job one of the best equipped machine jobs in the State. They made much progress, though the rains during the early contract period placed the whole job behind the time schedule. The contractors had the whole work roughed out by the end of the construction season and the job will be finished by late spring.

The excavation is moved from the shovels to the fills by tram cars hauled by dinky engines where the grade will allow and by hoisting engines the rest of the time. To take 20,000 cubic yards from a rock cut and place it in a ravine makes a task for any transportation agency, and to move 680,000 cubic yards is a similar task multiplied over and over again.

EQUIPMENT

The following equipment was used on this highway: steam shovels—two ¾-yard Erie, one 1-yard Bucyrus, one 1¾-yard crawler type, two 1¼-yard Thew, one 1½-yard Marion; concrete mixers—one 1-bag Wonder, one 1-bag Ideal, two 1-bag tilting Jaeger, two 2-bag non-tilting Leroy; hoisting engines—one steam, one Clyde gasoline, two 16-horsepower Orr & Sembower; well diggers—two 6-horsepower Ferguson, one 4-inch and two 6-inch of other makes; compressors—two gas 2-inch drill O. K. Clutch & Machinery Co., one steam 16-horsepower Sullivan; dinky engines—one 18-ton Davenport and two of other make; tram cars—nine 5-yard narrow gage and six standard gage; one large road scraper. Sand was supplied by the Knoxville Sand & Gravel Co., Knoxville, Tenn. Explosives were supplied by the Atlas Powder Co. and consisted of 40 per cent 1¼ x 8-inch stick dynamite, 60 per cent nitro glycerine 5 x 16-inch sticks and 40 per cent blasting powder. Hermitage, Royal and Churchfield cement was used.

ANDERSON COUNTY PAVING

The twenty-three miles of work in Campbell will be paved in a few years though the contract has not been awarded to this time. The fills will have to settle before a rigid pavement can be placed. Since Route 9 from North Carolina to Kentucky is one big project, the following description of paving work in Anderson County is typical of the work in this region:

Two contracts were let for paving during 1927; 8.09 miles south of Clinton and 9.45 miles north of Clinton, making a total of 17.54 miles. Both sections are portland cement concrete. This job comprises 185,200 square yards, or approximately 40,000 cubic yards of concrete. The yardage means 66,000 barrels of cement, 45,000 tons of stone and 23,000 tons of sand.

A good mixer working at capacity requires approximately forty batches per hour and there must be no hitch between the quarry or cement plant and the mixer. The movement of the tonnage of materials needed has made a paving job essentially a machinery operation. Short cuts must be taken wherever possible and forethought is necessary to keep the complicated operation constantly going.

STOCK PILES

On this job enough material was constantly in storage to run the mixer at least five days. Since the stone came but a short distance and came from a quarry of large capacity there was no shortage in deliveries to the stock pile. The sand was shipped a much longer distance but during the work there was no shortage from this source. The cement came from Nashville and it, too, was delivered on time. The operation therefore was to feed materials from the stock pile to the mixer as rapidly as it could be placed in the pavement.

PROPORTIONING

The proportioning was by volume measured in calibrated boxes, the boxes being fed from a twin hopper which could discharge sand and stone simultaneously. The measuring boxes dumped directly into the batch trucks which carried the batches to the mixer on the job. The cement was placed on each batch in bags and the bags were emptied at the mixer.

Early during the summer an inundator was placed on the job to save the contractor cement by getting the same amount of sand in each batch. After a month's trial, the inundator was discarded and the box method continued. The trouble came because the operator was

trying to pass sand through the device too rapidly. Instead of getting the correct amount of water to insure the exact number of sand particles he would get a too small amount of water and would get more bulking than was experienced by using the sand boxes. Another difficulty also arose as the wet sand was transported to the mixer. When it arrived the water in both batches might be in one batch or it might be along the road. This made it difficult, if not impossible, to regulate the consistency of the mix. To operate the device satisfactorily, full time must be taken in measuring the sand and the trucks which carry it to the mixer must be water-tight to avoid variations in water content when it goes into the skip.

HAULING

The hauling was by 2-batch trucks. The feature requiring special mention here was the high speed trucks used, the speed being approximately 25 miles per hour. By keeping the subgrade in good condition the high speed was maintained with a saving in the number of trucks. On a long haul this amounts to a large item since the number of trucks at low speeds will be much greater.

MIXING AND PLACING

The mixing and placing were by the usual methods, requiring no special description. The outstanding feature of these operations was the difference in efficiency between a well-worn mixer and one that was new. During the summer, the contractor made a faithful effort to bring both mixers up to maximum capacity for continuous runs. The old mixer could never reach more than sixty per cent of the number of batches the new outfit could place. When it is considered that each mixer controlled the speed of an operation that cost between $300 and $400 per day it is seen that a low efficiency increases the cost very greatly. The new mixer was able to attain a capacity of 36 batches per hour and hold it for several hours in succession. The older equipment was bothered by minor repairs, failure to function perfectly, and since it was old the operators would hardly deem it wise to force it to its greatest capacity.

FINISHING

The finishing behind the mixer was by machine, a longitudinal float, and a belt. The final surface was checked by a straight edge and brought to a surface that had no depressions or high places that varied from the surounding area more than ¼ inch. Where high places were left by the first finishing operations they were rubbed down by carborundum blocks. This operation proved quite tedious until a machine was brought on the works. It was driven by a small portable motor and consisted of a vertical shaft which operated arms holding carborundum blocks that could rotate about a vertical axis as they were rotated about the axis of the machine. This device would make the high places disappear very rapidly. One of the men on the job aptly said that it could cut down the bumps faster than the inspector could point them out.

CURING

The curing was by a coating of moist earth. This operation and the final finish on the subgrade probably require the most hand labor of all the operations connected with the paving. The concrete is too green to allow teaming and consequently the earth must be shoveled into place. It is removed, however, by a blade grader when the time comes for opening the road and finishing the shoulders.

The material and equipment used on the Anderson County paving job are as follows: two gas engine-driven Koehring concrete mixers, sizes 21-E and 27-E; two Ord finishing machines; two 5-ton Galion and one 10-ton Galion and one 10-ton Buffalo gas rollers; one grader and one block scarifier; several subgrade finishers; two longitudinal floats; six Adams fresnos and slip scrapers; one 1-man Galion, one 1-man Shawnee and one 12-blade Adams graders, one Koehring 1-yard and one P & H ½-yard gas crane. Sand was supplied by the Cherokee Sand & Gravel Co., Knoxville, Tenn., and the Southern Silicia Mining Co., Columbia, S. C. Hermitage cement was furnished by the Hermitage Portland Cement Co. Stone was supplied by Holston Quarry Co., Knoxville, Tenn., and gravel by the Cherokee Sand & Gravel Co., Knoxville, Tenn.

Responsibility and Highway Contracts

By W. F. Creighton

President, Foster & Creighton Co., Nashville, Tenn.

THE deplorable condition of highway contractors at the present time is the leading factor in bringing up the question of responsibility and its prerequisite for securing a highway contract, to such prominence. Over the entire country, prices are getting lower and lower, until I doubt if any profit will remain in most of the highway contracts let last year. I have been told on good authority of a machinery dealer in the South, and who has close contact with practically all the contractors in his state, that if it had not been for the extra long working season we had this year, and the two cuts in cement price, that he could name fifty contractors who would have gone under. The result of such low prices is that many conservative contractors have stored their equipment and others only employ one outfit, which enables them to keep in touch with the market and hold only the nucleus of a force employed. Many are watching events from the side lines, waiting for the deluge and the effect on the public when it comes. If contractors default, the bonding company usually pays the bills and finishes the work, but in many cases delays completion, and we submit that the loss to the public in the use of an important highway is much more than the saving resulting in the small percentage which exists between profit and loss to the builder.

A contractor should be required to demonstrate his responsibility before his bid is received. To do this he should: first, submit a bid on a lump sum basis; second, show that he owns sufficient equipment; third, show that he has successfully completed similar work; and fourth, show that he has cash or quick assets available for the work under consideration equal to ten per cent of the contract price on highway contracts.

The Associated General Contractors of America now has about 2500 members who do about one-third of all the work in the United States. They have recognized the seriousness of the problem of responsibility and have started campaigns of education. They first prepared an itemized schedule showing the cost of owning and operating equipment and emphasized the importance of including in the cost estimate a sufficient amount to cover interest, depreciation, repairs, obsolescence, etc. They have also prepared printed estimate sheets, which have been so thoroughly broadcasted that there is no excuse today for any highway contractor to leave out any item of indirect or overhead cost.

COOPERATION OF OTHERS NEEDED

There are several places where the contractors need the help of others. First: the method of opening bids, which is universally done by reading the unit price for each item, divulges very confidential information and enables the inexperienced bidder to submit bids on projects which he otherwise would not be able to do. This method sets aside the benefit of an experienced contractor's judgment because it is evident that even if he has carefully figured the cost to the best of his judgment, studied the project carefully for several days, located the source and cost of all material and knows from experience what profit is justified in proportion to the hazards of the work involved, he must disregard this knowledge and be influenced by the prices for work let in that neighborhood if he is to secure the contract.

THE MECHANICS LIEN IS DAMAGING

The next important condition that must be corrected is our primitive credit system. For generations, we have depended on our mechanics lien for our pay, but as we get further and further away from actual labor, we realize that lien laws hurt us more than they help. They enable irresponsible competitors to buy machinery and material without credit and obviate the effect of the retainer, by causing material dealers to carry it for them. The repeal of all lien laws is a long way in the future, but it will be the dawn of a better day for the construction industry when they are repealed and our business conducted on the proper credit basis.

INDEMNITY BONDS

The ease with which an indemnity bond may be secured is the third condition that must be corrected. Investigations by an A. G. C. Committee disclosed astonishing results of carelessness in selecting risks. The method of selling bonds is unsound and even in some carefully conducted agencies, the loss ratio is as low as 11 per cent, while the average of the entire company may be as high as 30 per cent. The results are that the rates have steadily risen until today they are 1½ per cent of the contract price. We do not ask that these rates be reduced, but believe that if more care were exercised, the resulting profit would be so great that the rates could be reduced.

THE LOWEST "RESPONSIBLE" BIDDER

Most laws affecting public work state that the job is to be let to the lowest responsible bidder. We know that the lowest responsible bidder is not the lowest price bidder, but this definition of responsible bidder is still indefinite to some public officials. The question is a comparative one: a man may be responsible in one line of work or contract and irresponsible in another. It is only when the contractor knows the limit of his ability and has the judgment to remain within those limits that he profits most.

Financial worth is the main but by far not the only requisite for responsibility, as skill and integrity are also essential. But if a contractor under the highly competitive market of the last few years has accumulated a cash surplus from this business and paid for certain equipment, it is an evidence that he possesses the other requirements. These limits of responsibility are determined by a questionnaire which various highway associations, institutes and surety associations have prepared, and which, if correctly made out, shows a contractor and everyone interested what he is worth financially and other facts needed to prove his ability and experience.

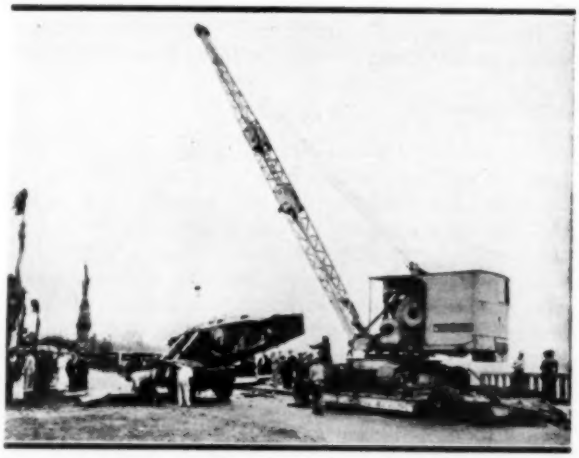
In discussing this question with other contractors, some think that a contractor's bank credit should be considered a quick asset. I am not sure whether or not this is logical as you will see that if the contractor only had a small per cent of cash it would have been necessary for him to borrow many thousands of dollars in addition for several months, and with a few jobs of any size on hand he would certainly use up an immense line of bank credit, as it must be remembered that highway jobs reach their peak during the summer months. I am convinced that it is absolutely essential for a contractor to have at least 10 per cent of his volume of business in quick assets and in addition a satisfactory line of bank credit, and still in addition that his equipment be paid for.

LESS DEPENDENCY ON ENGINEERS

Another important means of increasing the contractor's responsibility is to lessen his dependency on the engineer for information. One way this could be done is to require him to prepare his own estimate of quantities. It is entirely too easy to ride over a project, study previous bids, secure a bid bond and dive in. The present method also encourages bidders from a distance entering the competition with sometimes a mistaken idea of local conditions. I, therefore, suggest that you consider letting your work on a lump sum basis instead of unit price, but ask for the latter to be used in checking monthly estimates or for changes in quantities but not public information.

If a contractor has skill enough to do the work, he should be able to take off the quantities and determine the classification, and by the time he had made up his bid, he would certainly know something about the job. Quantity survey bureaus would soon spring up as in architectural work, from whom quantities would be purchased, but unit prices would not be public property and published to the world to encourage inexperienced bidders and overcome economic laws.

ACKNOWLEDGMENT.—From a paper presented before the American Road Builders Association at Cleveland, Ohio.

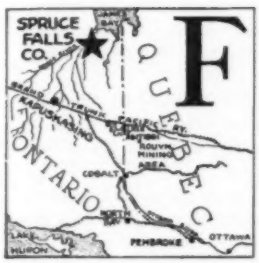


A KOEHRING CRANE ASSISTS A HYDROPLANE

One of a squadron of hydroplanes at the opening of the aviation field at Tampa, Fla. This plane was blown by a heavy wind from Tampa Bay, the engine going dead and the pilot barely making his way over the seawall in order to land in the Bay. The plane is not wrecked, as it appears, but had to be stripped of its wings in order to move it through the streets of Tampa. It is seen standing on an 8-wheel trailer. Photo courtesy of Coulter-Hart Equipment Co., Tampa, Fla.

Concreting at Sixty Below

By Wyatt B. Brummitt



FAR up in the Hudson Bay country, 150 miles from civilization, a wood pulp refining company acquired a magnificent tract of virgin spruce. It was almost literally a gold mine, a huge reservoir of sulphite spruce, from the pulp of which rotogravure printing papers, sanitary dressings and several other high demand products might be made. This tract is on the Moose River at the south end of the James Bay, north and east of Kapuskasing, Ontario.

But the Spruce Falls Co., which owned this land, was faced with what seemed an insurmountable difficulty. Winter was coming on and a factory had to be built in the heart of that valuable forest. The conditions called for a modern reinforced concrete building, but concreting in the north woods far from established markets of labor and material, under extreme weather conditions, was not a prospect to encourage builders.

Engineer after engineer turned down the opportunity

The Wilderness Where William Morton Started Operations, 150 Miles from Civilization

to do the work. To most of them 60 degrees below zero—a common Hudson Bay winter temperature—seemed an unreasonable temperature at which to do concrete work. In common with many builders in the States, they accepted as fact the old notion that concreting cannot be done successfully in cold weather.

More or less by accident, a representative of the company found William S. Morton, an engineer, who had made his way on three continents under all types of weather and labor conditions and who had emerged with a positive enthusiasm for jobs which had the appearance of impossibility. At the time Mr. Morton was at liberty. After brief negotiations, he packed his army trunk and started north on a trip of investigation.

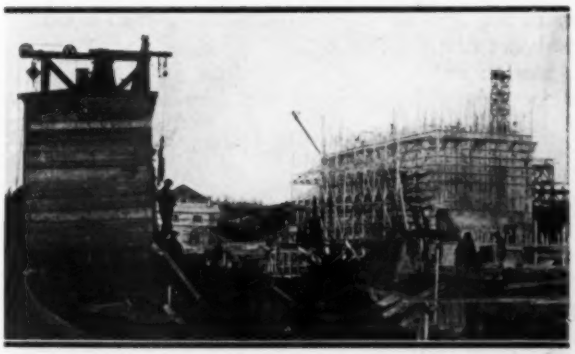
He went out alone into the wilderness and looked the situation over. The job appealed to him. He found a

William S. Morton, Whose Hobby Is Tackling the Impossible

likely site for the project, made a casual survey of the vicinity and returned to civilization. He sent for a boss electrician, a master mechanic and a sulphite superintendent. He recruited his engineering staff from veterans of Canadian overseas forces, contracted for skilled labor at a price which topped the best American scale plus bonuses, and gathered together a small army of trappers, adventurers and what-not for his unskilled forces. The total outfit numbered about seven hundred men.

Then he built a railway. Most of the distance between civilization and the camp was over muskeg swamp which at that time of year had hardened sufficiently to serve as a foundation for track. Morton's crew built their railway, then, directly on top of the muskeg and progressed with it to the scene of operations. When it was finished they called it affectionately "The Muskeg Central."

There they were, surrounded by the finest growth of



Construction at 60 Below. All Equipment Was Carried in on the "Muskeg Central"

The Sulphite-Spruce Factory Nearing Completion

virgin spruce imaginable—and they had orders to use no more of it for their own purposes than they had to. They built a few log cabins of that wood, but all of the other construction was made of materials which came in over The Muskeg Central. Everything they used, for that matter, supplies, sand, gravel, came over the same road.

Naturally, the matter of power supply required immediate attention. Morton discovered that the river which flowed, beneath a thick sheet of ice, past the camp had a 15-foot drop at that point. He had two ditches dug, one to hold a turbine and another for a sluiceway. One of his scouts picked up a second-hand turbine which was set in the ditch; and when the water was turned on there was immediately available all the power needed to light the camp and turn the motors of the equipment.

Had the actual construction been undertaken back in the States at that time of year, elaborate precautions would have been considered necessary in order to protect the concrete from the cold. However, according to Mr. Morton, nothing that was done there was particularly elaborate.

"Most of the cold weather methods we used," he said, "have been used by other outfits. For our concrete we simply took these precautions: First, all the water that went into the mixer was boiling. Second, we heated our sand and stone over sections of culvert pipe in which we built fires of scrap lumber and underbrush. Then, when we had cast our concrete in the forms, we ran steam hose up to them, shoved the nozzles into the concrete and left them there until it was about to set. We did not use tarpaulins. On very cold days we took sheets of asbestos backed with wire and bent them over the tops of the forms, forming a sort of tunnel over the fresh concrete. Then we rigged up an electric motor with a fan, put heat behind it and shot a current of warm air through the tunnel. . . . The concrete came out first rate."

Morton and his men worked from October to April under these "impossible" winter conditions. In May the plant went into operation and has been going ever since.

Responsibility—A Pre-Requisite

THE demonstration of responsibility as a pre-requisite for securing a highway contract is a subject that interests every contractor and engineer vitally, according to G. F. Schlesinger, Director of Highways of Ohio, in a paper read before the American Road Builders Association at Cleveland, Ohio, recently. All public contracts of any size or importance can be entered into only after competitive bids are received. This in general is the legal requirement of all our states, and of our Federal government as well as many other governments, certain minor exceptions being made for emergency and small-sized projects. Highway contracts are no different in this respect from other public works contracts. Highway work, however, has been of such volume and is performed in such proximity to the public eye that both the official and contractor have been subjected to close public scrutiny in the procedure incident to the award of a contract.

While not fundamental law, competitive bidding to determine the lowest bidder is such a universal legal requirement on public work that it is erroneously looked upon by the general public as a basic principle of government.

Much could be said concerning the qualifications of an ideal, "Grade A," 100 per cent highway constructor. Without attempting to draw up detailed specifications for this hypothetical party of the second part, the writer considers that he should possess the following attributes: 1. character, 2. financial resources, 3. experience, 4. personal ability.

THE QUESTIONNAIRES

About three years ago, the Department of Highways of Ohio decided to require contractors bidding on highway improvement projects to submit with their bids a statement of their experience and financial qualifications. For this purpose the contractors were provided with forms to be filled in and sworn to before a Notary Public or other official authorized to take affidavits. About a year ago, the forms then in use were supplanted by new blanks based upon the recommendations of the Joint Conference on Construction Practices for use in investigating the responsibility of bidders. This Joint Conference was composed of representatives of the highway officials, constructors, surety companies and other commercial interests connected with the contracting industry.

The forms in use at present consist of two in number: the first being titled "Experience Questionnaire and Financial Statement" and the second the "Plan and Equipment Questionnaire." There is only one Experience Questionnaire and Financial Statement required at each letting regardless of the number of projects on which the contractor is offering bids. The

The Lowest Bidder

The primary objective of competitive bidding is to determine the lowest bidder. At first, this objective was the only one and, in many instances, is the only one today. Common sense and public good, however, require that the awarding authority should be given some discretion—that in some cases it would be bad public policy to give the contract to the lowest bidder. Hence most laws on the subject contain some such qualifying phraseology as "lowest responsible," "lowest competent," "lowest and best," etc. The new Ohio highway law that went into effect in January, 1928, changes the wording of this clause to "lowest competent and responsible bidder." When the lowest bidder is defined in such terms the question arises as to the degree of discretion permitted the awarding official by the law. There are many court decisions that give the awarding official ample authority to use full discretion in determining the responsibility of the lowest bidder.

Improper Bonding

It is a true and regrettable fact that many surety companies have furnished bonds to bidders thereby enabling them to receive contracts on which they proved to be dilatory or which they failed to complete. The entire highway industry has been injured beyond measure due to the inflated and automatic credit created for incompetent contractors by the surety bonds they should never have been able to secure.

Plant and Equipment Questionnaire, however, is required for each proposal, the reason for which is obvious. The following statement is included in the information furnished to bidders: "The information contained in the Financial Statements will not be made public, but will be returned to the bidder after awards are made."

According to W. R. Neel, State Highway Engineer of Georgia, and Chairman of the Committee on Cooperation with Contractors of the American Association of State Highway Officials, standard questionnaires are being used in the following states: New Mexico, Florida, Pennsylvania, Ohio, Kentucky, Wisconsin, Missouri, Georgia, Nebraska, Iowa, Delaware and Illinois. Counties, municipalities, the Federal government and private consulting engineers are also using the standard questionnaire approved and recommended by the Joint Conference on Construction Practices. The forms have been aproved and are being used by members of the Clearing House Section of the American Bankers' Association. Some highway departments require that bidders submit financial statements at stated periods to be kept on file in the department and revised from time to time.

It is not maintained that the use of the standard questionnaire will solve the problem of determining to whom the award should be made. It is believed that they are of the greatest aid to the awarding official in arriving at the correct decision. In many cases the contractor who is the lowest bidder is well known to the members of the department due to their experience with him in the past and the questionnaires are a formality. However, it frequently happens that newcomers appear as the lowest bidders and the question of their qualifications must be determined. Other means of investigation are, of course, not precluded. In Ohio, we receive a personal report and recommendation regarding the award from the Division Engineer in whose district the project is located. On all Federal Aid Projects, the Federal representative in the State is consulted before the award is made.

If there is doubt as to the responsibility of the lowest bidder, it is then up to the awarding authority to decide, after a conscientious and complete investigation, whether he is justified in making the award to a higher bidder. The fact that a bidder can give a construction bond guaranteeing the successful completion of the contract should not be considered sufficient grounds for awarding him the contract if his bid happens to be lowest in price.

CERTIFIED CHECKS REQUIRED

Until 1925, a bidding bond was permitted in Ohio, but the Legislature at that time enacted a law requiring that bidders on state road contracts be required to furnish certified checks with their bids. This law has been of great benefit in curtailing the undesirable bidder as, formerly, many bond agents distributed bidding bonds about as freely as their business cards.

The Highway Commission of Wisconsin has avoided the necessity of ever awarding to other than the lowest bidder by adopting a policy of classifying prospective bidders according to the size of the project on which, in their opinion, they are qualified to bid. This is a form of restrictive competition or bidding by invitation and it is extremely doubtful whether it would meet the requirements of the law in Ohio and other states. The necessity of the awarding authorities exercising their discretion still exists—before the receipt of bids rather than after. There are advantages as well as disadvantages to the method, but the Wisconsin officials report it to be very satisfactory in actual practice.

To summarize, a bidder who submits the lowest bid in competition should either be known to be responsible or caused to produce facts that will prove him to be responsible. It is accordingly the duty of every awarding body or official to make as thorough and complete an investigation of the bidders as time and legal authority will permit. For this purpose the Standard Questionnaires developed by the Joint Conference on Construction Practices will be found most useful. It is urged that all public agencies having the authority to award contracts adopt and use these questionnaires. In order to facilitate an exchange of information regarding bidders looking toward the ultimate establishment of a policy of rating contractors, a standardization of practice is most desirable.

The problem is one that cannot be solved by highway authorities alone. It is one that also vitally concerns the contractors, the surety companies, and all the commercial organizations providing materials, equipment, and finances to the highway industry. In deciding the basic question of whom should be the man on the job digging the dirt or pouring the concrete, the highway official is entitled to and must have the sympathetic cooperation of the entire industry.

SUBWAY CONSTRUCTION MOVIE.
INSTRUCTION TO WATCHMEN, RULE 1.
Watchmen are directed not to wrestle with pedestrians or to beat them up when trying to prevent them endangering their lives or limbs.
Watchman: Pardon me Miss You are following a very dangerous path.
Miss Step: Applesauce!
Watchman: Look out below!

This Subway Construction Movie is Reproduced from the "Bulletin" of the General Contractors Association, New York, and is an Excellent Illustration of How Some Accidents Happen on Subway Work. According to the Report, This Young Lady Was Only Slightly Bruised and Was in Fit Condition to Tell How Subways Should Be Built When She Was Taken from the Hole

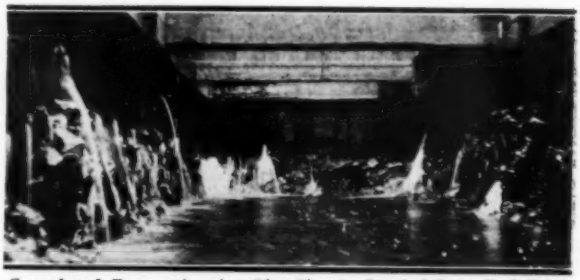
The Pecos River Bridge Project

By R. W. Bennett

Office Engineer, New Mexico Highway Department

THE one certain fact about New Mexico streams is their uncertainty. They have a sinister reputation for upsetting supposedly known facts and in failing to conform to the rules laid down by the hydrographer for the control of water courses. Stream beds slowly built up through the centuries suddenly become subject to scour, undermining foundations and substructures thought to be permanent. Bridges that have stood for five, ten, and thirty years are swept away by record-breaking floods. Channels here today are elsewhere tomorrow. A structure placed to span a stream a decade or more ago may unexpectedly find itself isolated some morning with its favorite river roaring sardonically in a new stream bed several hundred feet to the right or left.

In 1923, New Mexico Federal Aid Project No. 23 was constructed near Fort Sumner, famous for being the last rendezvous, the scene of the killing, and final resting place of Billy the Kid, notorious outlaw. The project formed a part of what was then and is still locally known as the Abo Pass Route, but now designated as transcontinental United States Highway No. 70, which traverses the state from east to west, entering from Texas near Clovis, touching at Fort Sumner, Vaughn, Mountainair, Socorro and Quemado, and crossing the Arizona boundary near Springerville. Project No. 23 was 9 miles in length and in the form of an inverted letter L; this irregularity in alignment having been determined by two control points, one being Fort Sumner, the other an existing steel bridge structure three miles south of Fort Sumner spanning the Pecos River.



Completed Excavation for Pier No. 4, Carried Into Bed Rock for Anchor. Solid Rock was 11 Feet Below the Stream Bed

Details of Steel Erection on the Pecos River Bridge Showing the Sixth Span of 252 Feet

The sacrifice in highway alignment made for the purpose of including the old bridge and thus to save the expense of a new one, proved futile. The Pecos River, a wide, sandy and ordinarily peaceful, stream, went on a rampage in September 1923, and following a previously observed tendency to shift its channel to the west, tore out one hundred feet of embankment approach. Temporary repairs were effected by the addition of several wooden spans to the old structure and the building of revetment work. However, the State Highway Department viewed these measures in the light of emergency repairs and set about toward the establishing of a permanent bridge and better highway alignment.

Relocation Determined

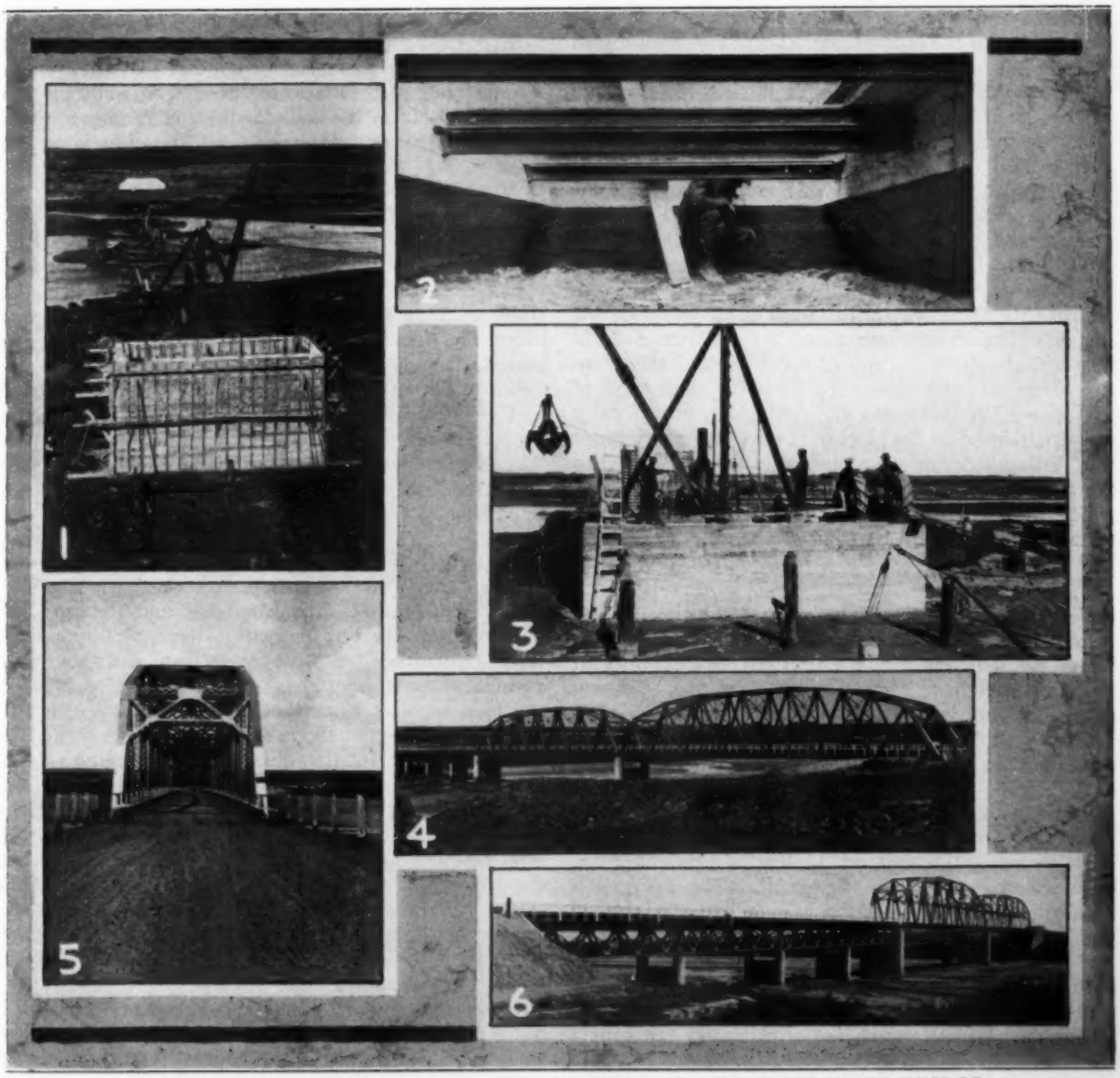
After making a careful survey of the river and vicinity for several miles upstream from the old bridge the site for the new structure was finally selected. This new site not only provided suitable banks for location of abutments and approaches and solid rock within reasonable depth upon which to rest foundations, but permitted the new highway location to go almost due west from Fort Sumner, thus eliminating a wide salient and clipping 5 miles in distance from an important transcontinental route. This necessitated the abandonment of 7.3 miles of constructed Federal Aid highway, but the resulting benefits were so great that neither the Bureau of Public Roads nor State Highway Department objected to the change.

Detailed surveys were made for the bridge and its connecting highway from Fort Sumner, a great deal of care being taken in making soundings and drilling test holes at the bridge site for the purpose of designing a

safe, economical and well proportioned structure. The determined length was 800 feet and the original idea was to construct it in eight equal spans of 100 feet each. The drilling investigations, however, proved that bed rock for safe foundations lay at a depth of 30 to 40 feet on the south 500 feet of channel, while on the north 300 feet it was 6 to 10 feet below the stream bed. To eliminate as much expensive pier excavation and construction in quicksand and water as possible, a change in plans was effected, the bridge engineer finally determining four spans of 75 feet and two each of 250 feet as being the most economical relation between span length and excavation depth. This brought only one pier in the deep part of the channel. On such a basis, the final detail plans were prepared and the bridge built. It consists of four 75-foot steel deck truss spans on the north end and two 252-foot through truss spans on the south end, all resting on abutments and round nosed piers of reinforced concrete carried to bed rock foundation. The structural steel work is designed for a loading of two 15-ton trucks and the clear roadway is 19 feet. Bids for the construction were opened by the State Highway Commission June 22, 1926, the contract awarded to the Pueblo Bridge & Construction Co. of Pueblo, Colorado, the low bidder, and actual construction began July 21, 1926. The contract stipulated 250 working days as the time for completion.

CONSTRUCTION

No serious high water was encountered during construction and the work of excavation for the abutments and piers 1, 2, 3 and 4 was comparatively simple. The



PROGRESS PHOTOGRAPHS OF THE CONSTRUCTION OF THE PECOS RIVER BRIDGE

1. *Bottom 15-foot unit of concrete cofferdam, Pier No. 5, in place and starting to submerge. 2. Interior of concrete cofferdam, Pier No. 5. 3. Bottom section of concrete cofferdam partly submerged, showing orange peel dredging outfit and pump run by Fordson. 4. Completed bridge viewed from south side of river. 5. End elevation of completed bridge. 6. Finished structure viewed from the north side of the river.*

Pecos River Bridge with Substructure Completed, Showing the Falsework and Traveling Derrick for Steel Erection on the Fifth Span, 250 Feet in Length

depth of foundation rock was from 6 to 10 feet, as was expected. Wooden cofferdams were employed to hold the sand out of the excavations. These cofferdams were built in the usual way using 8 x 8-inch timbers for frames, or wales, and 2 x 6-inch lumber for sheeting. They were built full height at the pier locations and driven down as the excavation progressed. Excavations were carried from one to three feet into solid rock to insure against their being moved by heavy floods. Considerable water was encountered but handled satisfactorily with a 6-inch pump. The pump pit was located at one end of the cofferdam outside the neat lines of the proposed footing. During the placing of concrete the cofferdam was lined with tarred paper which turned the inflowing water down along the walls to a drain box laid along the bottom of the hole, and thence to the pump pit. By concreting from the pump end of the excavation and using the drain box, no difficulty was experienced in the placing of concrete, as all water was deflected downward along the walls and forced to the end of the drain box by the body of fresh concrete which was deposited in a mass and allowed to move through the water by its own weight.

COFFERDAM FOR PIER 5

For Pier 5, where solid rock foundation lay 33 feet below the stream bed, the excavation called for different methods and it was here that the capability of the superintendent, Thomas Gross, and the efficiency of his organization were manifest. A concrete cofferdam was employed for this work: 29 feet long, 12 feet wide and 34 feet high. This cofferdam was built with outside faces vertical, the walls being 2 feet 3 inches thick at the bottom and 1 foot thick at the top, heavily reinforced with steel, railroad rails being used for cross bracing. The bottom 15 feet of this cofferdam were constructed as the first unit. The excavation within the cofferdam was made by a half-yard orange peel bucket operated from a stiff leg derrick with a 30-foot boom and powered by a 30-horsepower steam hoist. A 6-inch pump operated by a Fordson tractor was at first used to keep the excavation dry enough to handle. Heavy gravel was struck after the cofferdam had been sunk 10 feet and such a volume of water encountered that this pump was unable to handle it. The remainder of the excavation was therefore made without pumping as the gravel was coarse enough to permit the bucket to operate without great loss of material due to the washing action as it was raised through the water.

After the cofferdam had been sunk about 20 feet, its own weight was insufficient to force it down through the heavy gravel. Platforms were then built on top extending outside the walls of the cofferdam on which were placed boxes filled with sand, thus providing the extra weight necessary to effect penetration as the excavation proceeded.

When the cofferdam was settled on bed rock, which was fortunately practically level and fairly smooth, two pumps, one 8-inch and one 6-inch, were installed to unwater the interior and then to hold back the water so that the excavation could be carried down about one foot into the rock. The excavation completed, the pumps were pulled and the cofferdam allowed to fill with water. A seal coat of concrete about 10 feet in thickness was then placed in the bottom, the pouring being done under water by means of a bottom dump bucket. After allowing this seal coat to set two days, the cofferdam was again pumped out and the remaining 24 feet filled with concrete.

BRIDGE COMPLETED RAPIDLY

When this work was completed, the uncertain and major item of the job was finished and the work of building the pier was pushed forward rapidly. Fortunately, weather conditions were ideal and there was no high water encountered. On setting final points for the pier location, after the footing was completed, it was determined that the cofferdam had been settled at almost the exact location desired, one axis being off one and one-quarter inches, while the other axis missed by only one-quarter inch.

The substructure once completed, the erection of steel was marked by rapid progress. The trusses for the 75-foot spans were each received in one piece. This greatly simplified the erection as no falsework was required for the north 300 feet of bridge. The two long spans were, of course, erected on falsework, but luck was again with the contractor. No high water hampered operations, and all steel for these spans was hauled out into the river bed on wagons and raised immediately to position. A traveling derrick greatly facilitated the work of erection and no hand handling of steel was necessary.

The Pueblo Bridge & Construction Co., the builder, is fortunate in having in its organization such a man as

Superintendent Thomas Gross, whose ingenuity and ability to meet any condition that may arise, are, to say the least, exceptional. The State of New Mexico is likewise fortunate in having had Mr. Gross assigned to this particular project and thus securing a piece of construction which carries out the design and specifications of the bridge department in every particular. It is a splendid job from every standpoint.

The contractor, in bidding in the bridge contract, also acquired the connecting highway construction of three miles. The final estimate on the entire project amounted to $159,177.83, of which $115,306.12 represented the cost of the Pecos River Bridge. The preliminary estimate for the work based upon the contract unit prices was $156,068.13. The overrun of only $3,109.70, represented by the difference in quantities encountered from those estimated, speaks well for the care taken in preparation of the plans and preliminary estimate of quantities.

Of the 250 working days allotted for the construction of this contract, 238 were required by the contractor, marking this project as one of the few in the state completed within the time limit assigned.

Contractors Develop Forceful Warning Signs

THE mere statement "Road Closed to Traffic" seems to mean nothing to the average automobile driver. He probably drives around it and onto the new pavement. Today, it takes something unusual or startling to make the motorist stop and think. The Joseph Kinzley Co., contractors of Hackensack, N. J., have developed the warning sign reproduced below. This photograph was taken in Hackensack, N. J.,

EFFECTIVE WARNING SIGNS

At top, permanent sign devised by Joseph Kinzley. Below, a unique and home-made, but effective, warning sign.

Parsons Model-21 Excavator Working on Sewer Trench in Hackensack, N. J.

where the Kinzley Parsons ditcher was at work on the shoulder of the road digging a trench for a sewer line.

Joseph Kinzley, Jr., President of the Joseph Kinzley Co., writes us as follows regarding the sign: "The adoption of these signs was like the creation of most needful things. We seemed to win job after job on heavy traffic highways. Speeding motorists were the banes of our existence. Barricades and warning signs were ignored. Accidents were frequent.

"Our Joseph Kinzley, 3rd, outside man, experimentally designed two signs like the one you photographed and placed them 300 feet from each end of a deep cut across the Cedar Lane Road in Teaneck, N. J. This is the highway used by all traffic from the 125th and Dyckman Street ferries, New York City (heaviest traveled ferries out of New York City). Holiday and Sunday traffic is as heavy on that road as on any in the New York metropolitan district.

"It was surprising to note the change in the moving lines. The first driver to spot the sign jammed on his brakes as if an explosion had occurred ahead. There was some blasting. From time to time we observed the motorists. That was two years ago. Since then, one of the first things we send out on the job are the 'Go Slow' signs. They have paid dividends mentally as well as financially."

Another sign which has proved equally as helpful is reproduced below. It is a distinctly crude affair, but was observed to be particularly efficient as every motorist was seen to come to a full stop before making a sharp left turn to a point where the bridge had been removed from its abutments to a temporary position about 25 feet upstream at Fishkill, N. Y.

Photographs of equally forceful warning signs developed by contractors and their employes will be welcomed for publication in CONTRACTORS AND ENGINEERS MONTHLY.

The Contractors' Story of the Moffat Tunnel

A MOST interesting booklet has been prepared by Hitchcock and Tinkler, Inc. of Denver, Colo., the contractors who built the Moffat Tunnel, relating in descriptive terms and with illustrations the contractor's own story of this huge construction enterprise. Every operation in the entire work, from the dreaming of the tunnel by David H. Moffat, banker, miner, railroad builder and empire dreamer, to the touching of the golden key at Washington by President Coolidge which blasted the last barrier away and made a hole between the Atlantic and Pacific watersheds, is vividly portrayed.

The many phases of construction are discussed, as well as the camps, labor, power, shops, explosives, etc., used in the building of the tunnel which is sixth in length of the railroad tunnels of the world, and which involved the excavation of three-quarters of a million cubic yards of rock, and the erection of fifteen million feet of timber.

Local Material Saves Road Project

By G. L. Logan
District Engineer

George L. Willis, Sr.
Editor, Kentucky Highways

Kentucky State Highway Department

KENTUCKY closed the building season of 1927 with nearly 4,000 miles of highway under state maintenance, with $18,000,000 worth of road and bridge work under contract for completion by July 1, 1928, and with a 5-year program involving contracts with some 60 counties, just half the counties of the state, to spend in the next four years approximately $60,000,000 for work in these counties alone.

A 26.2-Mile Problem

The biggest undertaking by any single contractor, one that required the greatest vision on the part of the Kentucky state engineers, and the best business judgment on the part of the contractor, involved only one-tenth of the state's biggest undertaking. It is the 26.2 miles between two centers of industrial development in the mountains of Kentucky—that is, between Harlan on the north to within 5 miles of Pineville, where finished roads are already built out and through Middlesboro and Cumberland Gap into the south and east. This job is a part of the Mayo Trail, which is one of the most scenic as well as important through highways of Kentucky. This mountain thoroughfare when completed will traverse 8 counties through a distance of approximately 250 miles, connecting such important towns as Ashland, Louisa, Paintsville, Prestonsburg, Pikeville, Whitesburg, Harlan and Pineville, which will open a vast territory formerly untouched by highways or railroads. Approximately 110 miles of the Mayo Trail have been graded and drained, 25 miles have finished surface, and 40 miles are under construction, leaving a total of 75 miles for further work.

Heavy Rock Cut on Grading Work. This Photograph Was Taken at a Point Immediately Above the Ferry Shown in the Next Illustration

Shipped-in Material Prohibitive

The Mayo Trail passes through the mountains of southeastern and northeastern Kentucky, and the rugged topography of the whole route in general provides innumerable obstacles that enter into the path of modern economical highway construction. The entire mountain and surrounding region is practically barren of any limestone or first-class sand and stone that could be used to surface the highway. To use shipped-in materials for any type of surface or drainage structure would be extravagant, as the materials must be hauled in some sections as much as 30 miles over a mountain trail that cannot be traveled any part of the year with heavily loaded trucks or wagons, because of its roughness and the excessive grades. The mere problem of getting cement to the job has been serious enough, as can be seen from one of the illustrations showing a 2-horse wagon and improvised ferry.

Ferrying Cement Across the Cumberland River for Use in the Pavement on the Bell-Harlan Road. This Ferry Was Built and Operated by the Contractor and Was His Only Means of Getting Cement to the Job

Testing Laboratory Saves the Day

The Highway Department realized that it would take an abundance of money for the surfacing of this road using any of the standard type designs. On the completion of the location of the entire route, the Material Testing Laboratory of the State Highway Department immediately made material surveys to find local materials that would be suitable and which would cut the cost of construction.

An almost inexhaustible supply of sandstone is available along the entire route, and it was this material that the laboratory selected for its experiments with sandstone concrete. Numerous field investigations were conducted and rock was taken from the most likely looking ledges, sent to the testing laboratory, tested and used as an aggregate for concrete. The per cent of weau

Shovel Working in Quarry Where Sandstone Is Loaded into Cars and Hauled to the Crusher

for most ledges was not greater than 5 per cent and the toughness was not less than 8. The tests proved so satisfactory that contractors on several grade and drainage projects along the route located many miles from the railroad were permitted to use this sandstone as a fine and coarse aggregate in concrete on bridge and culvert structures. Because of the small quantity of concrete used on these sections, the contractors were not equipped to properly prepare the fine aggregate as it should have been. The results obtained, however, were so satisfactory that the Highway Department made further tests to determine whether this sandstone concrete could be used successfully for surfacing.

SANDSTONE FOR SURFACE AGGREGATE

In the early part of 1925, the 26.2-mile grade and drain project in Bell and Harlan Counties was nearing completion, and the Department was ready to let the contract for surfacing. With this in view, the Materials Testing Department confined its efforts to this particular section of the Mayo Trail, obtaining numerous samples of local sandstone with the idea of securing the best possible sandstone quarries in the section. Tests indicated that sandstone could be obtained in the proposed quarries with a per cent of wear of from 4.5 to 6.0 per cent and a toughness of not less than 9. Concrete test cylinders and concrete beams were made, using this sandstone properly prepared as a fine and coarse aggregate. Both cylinders and cores drilled from these were tested, and conclusively proved that concrete having a compressive strength of 3,000 pounds per square inch could be obtained, using this sandstone with a standard 1:2:3½ mix.

ALTERNATE BIDS ASKED

Early in April, 1926, bids were asked for surfacing the entire 26.2 miles in three separate sections and also as a whole on the following alternates:

1. *a* Illinois type concrete pavement 1:2:3½, using shipped sand as fine aggregate.
   b Illinois type concrete pavement 1:2:3½, using shipped crushed limestone as coarse aggregate.
2. *a* Illinois type concrete pavement 1:2:3½, using shipped sand as fine aggregate.
   b Illinois type concrete pavement 1:2:3½, using local crushed sandstone as coarse aggregate.
3. *a* Illinois type concrete pavement 1:2:3½, using local sand from sandstone as fine aggregate.
   b Illinois type concrete pavement 1:2:3½, using local crushed sandstone as coarse aggregate.

Penetration macadam—shipped-in materials.

Bids were submitted on each type and each section. The Faulkes Construction Co., Terre Haute, Ind., was the only contractor to bid on the alternate using local sandstone as a fine and coarse aggregate for concrete on all three sections or on the whole 26.2-mile section. This company's bid was considerably lower than the combined low bids on individual sections or the low bids on the combined sections using shipped-in aggregates. The total 26.2-mile section was awarded to the Faulkes Construction Co. in May, 1926, for $720,714.38. The contract called for the completion of all three sections in 400 calendar days after the contract was awarded: The contractor had made this bid in the face of the evident facts that the limestone in which central Kentucky abounds could never be hauled to this all-concrete job at a cost within reason, and knowing that his plan and the state's plan to test out the practicability of using native sandstone for both coarse and fine aggregate involved the purchase of a $50,000.00 crusher plant, and even then might prove a failure. The breaking of any part in the crushing plant would mean a round trip of 300 miles for a motor truck, and such an unforeseen accident would result in the forced suspension of the work of two big pavers and mixers and two big crews working at points at some distance from each other.

CONTRACTOR STUDIES JOB

Between the dates of advertising and letting, the successful bidders on this work made a very careful study of the actual conditions that existed along the entire job, and in consequence were ready to begin operations a very few days after the contract was awarded to them. A quarry was opened along the mountainside at the approximate center of operation. At the same time machinery was being sent in and erected for the screening and washing plant. The stone in the quarry at Pine Mountain lies in a diagonal plane, which is attributed to a mountain fault. This condition makes drilling and shooting very difficult, as it necessitates the moving of these ledges in single lifts. The equipment used was especially designed and installed by the Good Roads Machinery Co., and consists of two No. 6, 12 x 26-inch jaw crushers, one No. 4½, 10 x 20-inch

The Largest Crushing Plant in Kentucky Owned and Used by Contractors in the Successful Experiment of Utilizing Local Sand Stone Crushed for Both Coarse and Fine Aggregates on the Bell-Harlan Road

jaw crusher, buckets and endless belt conveyor, one large storage bin of three compartments of 100 tons capacity each, one sand agitator, one gasoline pump, two 60-horsepower diesel engines and several sizes of screens.

CRUSHING AND WASHING SAND AND STONE

After the stone is shot down and broken up in the quarry it is inspected, and any stone containing streaks of coal, laminated or otherwise objectionable, is rejected before it is loaded into the cars. The stone is loaded into the 12-yard cars with a ¾-yard Osgood steam shovel. The cars are then drawn up an incline by a hoist and dumped directly into the two No. 6 crushers. The stone, after passing through the two crushers, is carried up in buckets on an endless belt conveyor and dumped into the screens. The stone passing over the 2½-inch screen together with the tailings is carried back by a chute into the No. 4½ sand crushers and crushed into sand, and returned by conveyor belts to the screens to be separated and washed. The sand is separated from the stone by means of a ⅜-inch jacket wrapped over the ¾-inch openings. It has been closely estimated that approximately one-third of the sand is made by the two No. 6 crushers.

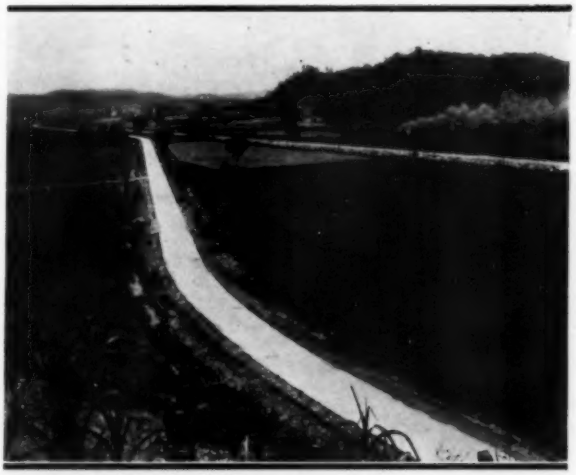
The stone is washed by a 4-inch perforated pipe placed inside the screen. Between 250 and 300 gallons of water per minute for washing are supplied by a gasoline pump from a nearby stream. The sand is carried into the sand settling tank, which is located at one side and below the screen, and is agitated by revolving paddles. These paddles carry the sand up and into the sand bins. By regulating the weir in the end of the wash box the amount of fine material can be controlled. The contractor is contemplating replacing the No. 4½ sand crusher with a roller-type crusher, as the amount of sand now being made with the No. 4½ sand crusher is hardly sufficient to supply two pavers.

FIELD TESTS SATISFACTORY

A field testing laboratory is maintained at the plant where numerous daily tests are made for proper gradation of materials and wash tests are made on the sand. Concrete cylinders and beams are also made here for special tests and modullus of rupture. The cylinders and beams are sent to the Highway Department Materials Testing Laboratories. The average strength on test cylinders to date has been a little above 3,100 pounds per square inch. The contractor has experienced no difficulty whatever in the finishing of this sandstone concrete as at first was anticipated, and the finished pavement represents a very smooth and neat looking job. If weather conditions remain suitable this job will be completed on or before the contract date. The successful use of local material for sandstone concrete, which now appears to be almost certain, will mean a high type surface on a major portion of the entire route as well as economical construction.

FIFTY-FIVE PER CENT COMPLETE

The work has been under way for some sixteen months, twelve of which were probably the most unfavorable from the weather standpoint of any similar period of road building in Kentucky. Two stretches, one of 5.2 miles and one of 9.5 miles, or a total of 14.7 miles, are entirely complete, making the job 55 per cent complete.

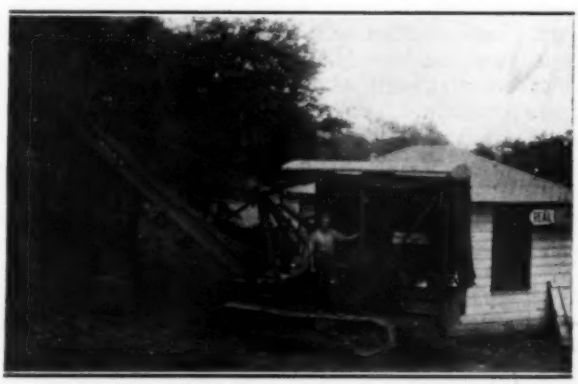


A Stretch of the Completed Portion of the Million Dollar Job

Two mixers and pavers "made hay" during the beautiful fall weather that prevailed after the rains abated and the entire piece of work was nearer complete at the end of this building season than was hoped for.

CONTRACTORS AND ENGINEERS PULL TOGETHER

Kentucky is at the moment blessed with a very fine organization, and with a small army of contractors who have popularized themselves with the Department and the citizenry by their evident desire to give worth-while work at prices the state can afford. Kentucky's bills for August, for example, for road work, including new construction, reconstruction and maintenance, broke the state record, aggregating more than two million dollars. The marked feature of all this to those who watch and study this side of the state's road problem is the fact that this work cost the state an average of 33.1 per cent less than the same character of work cost four years ago, whereas the average cost of engineering was 4.5 per cent in August as against 8 per cent in August, 1926, a one-third decrease in the cost of construction and 100 per cent increase in engineering efficiency.



Insley Excavator Owned by Rockland Motor Haulage Co., Blauvelt, N. Y. At Quitting Time After a Hard Day's Work at the Base of the Palisades in South Nyack, N. Y.

Who's Who in Construction

A Series of Reports from Active Contractors Published Monthly

BUS. VOL.—ANNUAL VOLUME OF CONTRACTS
A—Over $5,000,000
B—Between $1,000,000 and $5,000,000
C—Between $500,000 and $1,000,000
D—Between $250,000 and $500,000
E—Under $250,000

New Mexico Construction Co., Inc., Albuquerque, New Mexico, 3rd and Gold Streets. Branch offices: Denver, Colo.; Greeley, Colo.; Clovis, N. M.; Carlsbad, N. M. Organized April, 1920. Bus. vol. B. The company was organized by A. R. Hebenstreit, then Vice-president, with W. J. Rand, President. Mr. Rand sold out his interest in January, 1925. Officers: A. R. Hebenstreit, President; V. K. Jones, Vice-president; N. M. Switzer, Secretary-Treasurer. Major contracts: Evergreen Dam; paving in Albuquerque, Clovis Tucumacri, Carlsbad, Denver and Greeley; Albuquerque Reservoir. Member: A. G. C. of A.

Clinton Bridge Works, Clinton, Iowa. Organized 1892. Bus. vol. C. This plant was originally established in 1868, and is the oldest structural steel plant in Iowa. Officers: G. E. Wilson, Jr., President; J. F. Wilson, Vice-president; F. E. Wilson, Secretary. Member: American Institute of Steel Construction, and A. G. C. of A.

H. J. Gilbertson Construction Co., Memphis, Tenn., 166 Monroe Avenue. Organized 1919. Bus. vol. C. The partnership was reorganized in 1924. Partners: H. J. Gilbertson and J. A. Angus. Major contracts: 1925, St. Mary's Cathedral, Memphis; 1926, Memphis Eye, Ear, Nose and Throat Hospital, and Elks' Lodge and Club Building and Hotel, Memphis; 1927, Farnsworth Building, Memphis. Chamber of Commerce, and Memphis and National A. G. C. of A.

Wm. M. Bailey Co., Boston, Mass., 88 Broad Street. Organized April, 1915. Bus. vol. D. Wm. M. Bailey is one of the first engineers to design and build structures of reinforced concrete in the United States. As engineer for the Eastern Expanded Metal Co., he designed and supervised the construction of the first flat-slab type of floor; this was in 1900. This company has always specialized in concrete work, but also constructs other classes of buildings. Officers: Wm. M. Bailey, President and Treasurer; Frank M. McGowan, Vice-president. Member, Building Trade Employers Assn., Boston, Mass., Associated Industries of Massachusetts, and A. G. C. of A.

Frank N. Goble, Inc., White Plains, N. Y., 49 Brookfield Street. Organized 1903, incorporated 1922. Bus. vol. D. The business was organized by Frank N. Goble and Wm. J. Goble, and in 1926 M. Y. Pietschker purchased part interest in the company, as did C. F. Sanford and T. H. Cole, who joined the company in 1916. Officers: Frank N. Goble, Chairman of the Board; Wm. J. Goble, President; Chas. F. Sanford, Vice-president; Thos. H. Cole, Treasurer; and M. Y. Pietschker, Secretary. Major contracts: 1925, 1926 and 1927, residence, hospital, church, store, apartment, swimming pool, bank, club house and other building construction, totalling $1,876,300. Member, Westchester County Chapter of A. G. C. of A., White Plains Chamber of Commerce, Westchester County Employers Association, and U. S. Chamber of Commerce.

Wm. J. Goble

Thos. H. Cole

Chas. F. Sanford

M. Y. Pietschker

A. W. Quist Co., Seattle, Wash., 310 Hoge Building. Organized 1908. Bus. vol. C. Partners: A. W. Quist and A. S. Downey. Major contracts: 1924, St. Vincent's Home, Seattle, Providence Hospital, Everett, and St. Peter's Hospital, Olympia; 1925, St. Vincent's Hospital, Portland, Medical and Dental Building, Seattle, and American Can Co. building, Seattle; 1927, Mt. Baker Theatre Building, Bellingham, and Ballard Eagles Building, Seattle. Member: U. S. Chamber of Commerce, Seattle Chamber of Commerce, and A. G. C. of A.

The Juniata Co., Philadelphia, Pa., 410 Empire Building, 13th and Walnut Streets. Organized 1912. Branch office: King of Prussia, Pa. Bus. vol. D. Since its incorporation, this company has continuously engaged in highway construction and has lately undertaken, in addition, such work as building speedways, and landscape work, etc., on suburban estates. Officers: R. C. Jacob, President; J. M. Dallam, Secretary. Major contracts: In addition to above, is the motor speedway at Langhorne, Pa. Member: Associated Pennsylvania Constructors, and A. G. C. of A.

Central Contracting & Engineering Co., Detroit, Mich., 17567 Wyoming Avenue. Organized, 1923. Bus. vol. C. Officers: Harold C. McGregor, President; John H. Engel, Vice-president; J. J. Reading, Secretary-Treasurer. Major contracts: 1926, Ashland Avenue Sewer Sections 4 and 5; 1927, Ashland Avenue Sewer Section 6, West Michigan Trunk Sewer, Dearborn, Mich., 7-mile Annott arm sewer, and State Fair Avenue Arm Connors Creek sewer. Member: Michigan Municipal Contractors Association, and A. G. C. of A.

Woermann Construction Co., St. Louis, Mo., 915 Olive Street. Organized November, 1913. Bus. vol. C. The work of this company is confined to metropolitan St. Louis, and is general building. Officers: F. C. Woermann, President and Treasurer; R. E. Salveter, Secretary. Major contracts: 1926, Carondalet Y. M. C. A., Eden Emmanuel Church, and Polar Wave Ice and Fuel Company's Murdock Street plant; 1927, Polar Wave Ice & Fuel Company's Gratist Street plant, Biology and Women's Bldgs. of Washington Univ., St. Louis Co. Old Folk's Home, Pomegranate Masonic Temple, White Baking Co. plants. Member: St. Louis Chamber of Commerce, Engineers Club of St. Louis, A. G. C. of A.

George A. Fuller Co., New York, 949 Broadway. Branch offices: Boston, Mass., Chicago, Ill., Philadelphia, Pa., Washington, D. C., Miami, Fla. and Montreal, Canada. Organized April 1, 1901. Bus. vol. A. Officers: Hugh White, Chairman of the Board; H. S. Black, President; Vice-presidents, W. T. Smith, J. R. Kilpatrick, J. E. Fuller, E. S. Belden, W. G. Distler, R. S. Francis, Carl Brandt, R. C. Whiting, J. F. Manning, L. R. Crandall, J. F. McPherson, H. D. Symonds; B. M. Fellows, Treasurer; Faulkner Hill, Secretary and Counsel; Assistant Treasurers, J. W. Wright and H. G. Ripley; A. J. Flohr, Auditor. Major contracts: 1925, bank and office building for the Brotherhood of Locomotive Engineers, Cleveland, Ohio; Hotel Roney-Plaza, Miami, Fla.; Metropolitan Life Insurance Building, Ottawa, Canada; Lincoln-Alliance bank and office building, Rochester, N. Y.; Read House, Chattanooga, Tenn.; Scottish Rites Temple, Philadelphia, Pa.; Shelburne Hotel Addition, Atlantic City, N. J.; Cincinnati Enquirer office building, Cincinnati, Ohio; Wabash-Monroe office building, Chicago, Ill.; Stevens Hotel, Chicago, Ill.; Duke University, Durham, N. C.; Savoy-Plaza Hotel, New York; National Press Club Building, Washington, D. C. 1926, Hotel George Washington, Jacksonville, Fla.; Parker House, Boston, Mass.; City Hall Annex, Philadelphia, Pa.; 39 Broadway Building, New York; town development of Venice, Fla. 1927, Federal Reserve Bank, Baltimore, Md.; National City Co. Building, New York; L. Bamberger Department Store Addition "B," Newark, N. J.; and Royal Bank of Canada, Montreal, Canada. Member, Building Trades Employers Assn. in New York, Chicago and Boston. A. G. C. of A.

Hugh White

Woods Bros. Construction Co., Lincoln, Neb., 132 South 13th Street. Branch offices: Kansas City, Mo.; Chicago, Ill.; New Orleans, La., and Schreveport, La. Organized 1921. Bus. vol. A. Major contracts: Gulfport, Miss., sea wall; Starved Rock, Ill., locks and dam; Manhattan Oil Co. pipe line; and river bank protection work.

Paul Schriewer, Seguin, Texas, 209 Austin Street. Organized March, 1919. Bus. vol. D. Owner, Paul Schriewer. Major contracts: 1925, 16 miles hard surfacing Guadaloupe Co. Highway No. 3, and one school building; 1926, 10 miles hard surfacing Karnes Co. Highway No. 9, and other city and county contracts; 1927, furnishing gravel for three hydro projects on Guadaloupe River, paving the city of Luling, 15.5 miles base Gillispie Co. Highway and other contracts. Member: A. G. C. of A.

The Ferro Concrete Construction Co., Cincinnati, Ohio, Third and Elm Streets. Organized 1902. Bus. vol. A. Officers: W. P. Anderson, Chairman of the Board; Taylor Field, President; Este M. Lea, Vice-president; H. D. Loring, Secretary and Treasurer. Member: A. G. C. of A.

J. H. Findorff & Son, Madison, Wis., 601 W. Wilson Street. Organized January 1, 1920. Bus. vol. C. In 1890, J. H. Findorff succeeded the Stark Mfg. Co. Since that time, he has been in business at Madison, during which time he has built many of the outstanding buildings of the city, including the State Capitol and many of the University buildings. In 1920 Milton B. Findorff, his son, was taken into the business, and a partnership formed. Major contracts: 1925, St. Mary's Hospital; 1926, St. Clara College; 1927, Methodist Hospital. Member: Master Builders of Wisconsin, and A. G. C. of A.

Lichtefeld, Metzner & Co., Louisville, Ky., 989 Logan Street. Organized May 15, 1914. Bus. vol. E. This is a partnership composed of Fred G. B. Metzner and Fred J. Lichtefeld, both of whom were formerly connected with The Frey Planning Mill Co. A third party, Henry C. Lichtefeld, was a partner when the firm was organized, he, however, retiring from active business in 1926. Major contracts: 1924, Women's Club of Louisville, Highland Park Masonic Hall, Keher Building, and Ursuline Academy Building; 1925, J. B. Speed Memorial Art Museum, Ursuline Academy Building, Orphanage of the Good Shepherd, resident of Mrs. Wm. R. Belknap; 1927, Ursuline Academy Building; Cave Hill Cemetery Office addition, and residence of John Maas. Member: Louisville Board of Trade, General Contractors Association of Louisville, Chamber of Commerce of the U. S., and the A. G. C. of A.

Yeager & Sons, Danville, Ill. Organzied 1900. Bus. vol. C. This company began as M. Yeager in 1870. It became M. Yeager & Son in 1885, Yeager & Son in 1900, and O. K. Yeager became sole owner in 1923. Major contracts: High Schools, in Erie, Pa., and Greenville, Ohio; First National Banks in Richmond, Ind., and Danville, Ill.; Wolford Hotel, and Telephone Building in Danville, Ill. Member: A. G. C.

Newell Contracting Co., Inc., Birmingham, Ala., Martin Building. Branch office: Greenville, S. C. Organized 1916. Bus. vol. B. This company owns a concrete pipe company in New Orleans, La., which is the largest of its kind in the South. Officers: A. T. Newell, President; S. S. Newell, Vice-president; N. W. Newell, Secretary and Treasurer. Major contracts: contracts in Alabama, Georgia, Mississippi, Arkansas, Tennessee, North Carolina, South Carolina and Florida. Member: A. G. C. of A.

Left to right—Standing, S. S. Newell and N. W. Newell; seated, A. T. Newell, Oswald Newell and W. S. Newell

Chas. M. Dunning Construction Co., Oklahoma City, Okla., 420½ N. Hudson Street. Branch office: Norman, Okla. Organized 1919. Bus. vol. C. This business was started in 1907 by E. M. Lisle and Chas. M. Dunning as E. M. Lisle & Co., in Birmingham, Ala. In 1909 they moved to Oklahoma City, changing the name to Lisle-Dunning Construction Co. In 1918, Mr. Lisle died, and Mr. Dunning kept the business, changing the name to its present form. The company was incorporated in 1927. Officers: Chas. M. Dunning, President; John McCormick Dunning, Vice-president; E. H. Walpole, Secretary and Treasurer. Major contracts: 1926, Girls' Dormitorry of State University of Norman, Okla., Harbour Longmire Furniture Co., Oklahoma City, and Cotton County Court House, Walters, Okla.; 1927, McCulloch Office Building, Okmulgee, Okla., and Aberdeen Apartments, Oklahoma City, and other contracts. Member: Chamber of Commerce, and A. G. C. of A.

Legal Points for Contractors

These brief abstracts of court decisions in the contracting fields may aid you in avoiding legal difficulties. Local ordinances or state laws may alter the conditions in your community. If in doubt consult your own attorney

Edited by A. L. H. Street, Attorney-at-Law

Sign Hastily; Repent Leisurely

"I took the contract and looked at it, but I did not have my glasses with me and I was in a big hurry." That is the excuse that a Montana litigant offered for not familiarizing himself with an agreement he signed. But the Montana Supreme Court refused to see in it any ground for releasing him from his contract obligation (W. T. Rawleigh Co. Washburn, 260 Pacifis Reporter, 1039, disposed of November 25, 1927).

The court said that these "flimsy excuses" indicated that the signer needed a guardian to protect him from signing contracts, but that since he was of mature age and not laboring under disability, his obligation must be construed and enforced according to its terms.

Lowest Bidder's Right to Award of Contract

New Jersey, like many other states, has a law to the effect that municipalities must award important construction contracts to the lowest responsible bidder after advertising for proposals. Under these statutes most courts have recognized that municipal authorities have broad discretion in determining who is the lowest *responsible* bidder. But in a decision handed down October 31, 1927, by the Supreme Court of New Jersey, in the case of American Water Corporation vs. Mayor and Council of the Borough of Florham Park, 139 Atlantic Reporter, 169, it is held that the lowest bidder is entitled to a hearing before his proposal can be rejected on the ground of lack of responsibility. The court said:

"Under this statute the borough was obliged to award the contract to the" lowest bidder, "unless there was evidence that would justify a belief on the part of fair-minded and reasonable men that the lowest bidder would be unable to perform its contract. . . . One who is the lowest bidder is entitled to a hearing as to his responsibility before his bid is rejected."

Because the lowest bidder in this case was not given a hearing, an award to a higher bidder was set aside by the court.

Contract Without a Consideration is Like a Truck Without a Motor

"Gentlemen's" agreements are not enforceable in law. One of the vital elements of a contract is a consideration. There must be a recriprocal obligation of some kind.

So, the Texas Supreme Court, in an opinion filed October 19, 1927, decided that where a contract was entered into for the casting and driving of concrete piles for bridges, a subsequent promise to the contractor by the other party to furnish a hammer with which to drive the piles was unenforceable because not supported by any legal consideration. In other words, the original contract impliedly bound the contractor to furnish his own hammer, and the other party could not be held to a subsequent promise to furnish one, where he got nothing in return for the promise. Stone vs. Morrison & Powers, 298 South Western Reporter, 538.)

It was decided that the contractor's promise to resume the contract work was not a valid consideration for the other party's undertaking to furnish the hammer, because in returning to work the contractor was not doing anything that he was not already bound to do.

Crediting Payments on Account

A recent decision of the Mississippi Supreme Court draws attention to some interesting and important rules of law that are often overlooked. A debtor paid $25 to a creditor when in fact all of the items of his account, excepting $3.25, were outlawed. This was held to revive the whole account. (M. G. Travis & Co. vs. Mosley, 114 So., 628.)

It is quite well settled law throughout the country that where a debtor owes two or more debts to the same creditor and makes a single payment, he has the right to direct how the credit shall be applied. But he must give the direction when or before he makes the payment. He cannot do it afterward if the creditor objects.

So, contrary to the understanding of many laymen, the creditor has no right to disregard a direction given by the debtor as to how a certain payment shall be credited. The debtor may insist that the payment be applied to principal or interest, to a new debt to the exclusion of an old one that may be about to outlaw, to a secured debt to the exclusion of an unsecured debt, or otherwise.

If the debtor "passes," as he does by omitting to give instructions how the payment shall be applied, the creditor has a choice, provided he exercises it immediately. He may apply the payment to a note or an account, instead of a secured one, or he may credit any one or more of several items of a running account, but not a note or account that is outlawed or not due, if there are other debts that could be credited.

If the creditor also "passes," the law automatically applies the payment. It will be applied according to the probable intention of the parties, if that can be ascertained from the surrounding circumstances. In some states, the matter is covered by statute. In others, it is governed by common-law principles.

As a general rule, a court will credit a payment to interest rather than principal, to an interest-bearing debt rather than one not bearing interest, to a matured rather than unmatured obligation, to a secured debt rather than an unsecured one, and to items of account in the order in which they became due. But unless, as in the Mississippi case, the payment more than covers an outlawed debt no part of it will be applied to part that is outlawed.

Clearing Building Site Was Not an Extra

In the case of Favalora vs. Bourgeois, 114 So. 119, decided by the Louisiana Supreme Court July 11, 1927, it was held that a contractor erecting a building was not entitled to extra pay for removing trees from the site. The court approved the following statement made by the trial judge:

"The contractor agreed to build the house on a specified locus. He necessarily saw the situs, and whatever was necessary to locate the house thereon he contracted to do. If a rock were in the way, he had to blast it out. If a tree were in the way, he had to cut it down. He agreed that nothing should be charged for and allowed as an extra, unless the order therefor was given in writing, and the price therefor agreed on, in advance. . . .

"The contract is the law between the parties, and binds them to the same extent as do the laws passed by the Legislature."

Contractor Was Not Liable for Work That Collapsed After Acceptance, Although Before Payment

Contractors undertook to construct a bulkhead, according to certain plans and specifications, to prevent earth falling into a dock. The work was completed and the supervising architect approved and accepted it. A check for the amount due was drawn, but before the owner signed it he discovered that the bulkhead was bulging and thereupon he refused to settle. The contractors sued to recover what was due and the Virginia Supreme Court of Appeals affirmed judgment in their favor, in an opinion handed down March 17, 1927, in the case of Southgate vs. Sanford & Brooks Co., 137 South Eastern Reporter, 485.

The court found that the collapse was in no way due to the contractors' fault; that a provision of the contract that the work should be accepted when approved by the architect controlled a clause in the architect's final certificate that the certificate should not constitute an acceptance of the work; and that a provision in the contract requiring the contractors to take soundings and assume responsibility for local conditions in the prosecution of work did not make them liable for a collapse due to faulty plans.

What an Irrigation District Contractor's Bond Covered and Did Not Cover

A contractor to erect dams and an irrigation plant for a Texas improvement district gave a bond to "pay all sums of money due, and to become due, for supplies, teams, equipment, material, and labor used, or contracted to be used, in the performance of said contract," etc.

Interpreting this bond in the case of B. F. & C. M. Davis Co., vs. W. E. Callaghan Construction Co., 298 South Western Reporter, 273, decided by the Texas Commission of Appeals October 5, 1927, and approved by the Texas Supreme Court, it was held that the bond covered workmen compensation insurance premiums, the contract binding the contractor to carry such insurance.

It was further held that the bond covered goods sold to the contractor's employes through the contractor's stores, which it was necessary to operate, but not goods sold through those stores to the general public. Nor did the bond cover debts incurred by the contractor for general equipment and for parts and repairs therefor. The bond covered only things consumed in the prosecution of the work. And it was held that where the contractor used gasoline in prosecuting the work and sold some to the general public, the bondsman was not liable for gasoline furnished to the contractor, without proof as to what part of it was consumed on the job.

Construction Superintendent's Authority

In the course of a bridge building company's operations, but, perhaps, without legal fault of the company, an employe was fatally injured. Physicians were summoned by one Hogan, the company's superintendent, and they later sued the company for the value of their services. The company denied Hogan's authority to employ the physicians. But the North Carolina Supreme Court said (Miller vs. Cornell-Young Co., 122 South Eastern Reporter, 338, April 9, 1924):

"If Hogan were superintendent of the construction and had entire charge, had authority to buy materials and repair and mend the broken machinery and employ and discharge the workmen, did he not have implied authority to authorize plaintiffs to care for and administer to the broken and fatally wounded employe, under the facts and circumstances of this case?

" 'And he said unto them, What man shall there be among you, that shall have one sheep, and if it fall into a pit on the Sabbath day, will he not lay hold on it, and lift it out? How much then is a man better than a sheep?' St. Matthew, 12-11, 12.

"We think that Hogan had implied authority, under the facts and circumstances of this case, and acted within the scope of his employment in having plaintiffs care for and operate on the fatally wounded employe of defendant, and that plaintiffs were entitled to reasonable compensation for their services."

Highway Contractor's Bond Covered Rent for Equipment Hired by Him

A North Carolina road contractor gave a statutory bond to pay the claims of those "furnishing materials" or "performing labor" in the execution of his contract. The question was raised whether or not this bond protected a claim for rent for use of a steam shovel and boiler used in excavating operations. Answering this question in the affirmative, in an opinion handed down May 18, 1927, the North Carolina Supreme Court said in the case of Wiseman vs. Lacy, 138 South Eastern Reporter, 121:

"Such bonds are construed liberally for the protection of those who furnish labor and materials in the prosecution of public works, . . . and it is not thought that the surety can complain at such holding, or than any hardship is imposed thereby, because in entering into the contract the surety is chargeable with notice, not only of the financial ability and integrity of the contractor, but also with notice as to whether he possesses the plant, equipment, and tools required in undertaking the particular work, or will be compelled to rent and hire the same or some part thereof, all of which matters are factors to be considered in determining the risk and upon which the surety fixes the premiums exacted for executing the bond."

Owner's Promise to Subcontractor

But few court decisions spoil or get shop-worn merely because permitted to remain on a "shelf" until they are "dusty." In fact, it often becomes necessary to dig away back into the past to find a judicial precedent to fit a pending controversy.

The decision handed down June 20, 1895, by the Minnesota Supreme Court in the case of Grant vs. Duluth, Missabe & Northern Pacific Railway Co., 63 North Western Reporter, 1026, is just as good law today as it was when it was announced by the court.

The railway awarded a grading contract to Wolf & King, and they sublet part of the work to Grant. Wolf & King failed to make payments due to Grant and he refused to proceed further. Then the railway company promised him that if he would go ahead they would reimburse him against any losses already sustained under the contract and would pay him for work thereafter performed in completing the job.

But the railway company tried to avoid its liability under this promise, on the technical ground that there was no legal consideration for the promise. The contention rested on the fundamental proposition of law that a promise is not binding unless there is a consideration to support it. For example, a contractor's promise to build a house for nothing would not be binding against him. But the court found that there was sufficient consideration in this case, saying:

"It is no concern of plaintiff's that Wolf & King may have been willing to perform their contract with defendant. On account of the defaults of Wolf & King, plaintiff was not obliged to perform his contracts with them. If defendant saw fit to promise to give plaintiff an additional consideration for performing a contract which he was not obliged to perform, there is a sufficient consideration for that promise. That consideration may consist of detriment or disadvantage to plaintiff, or waiver of a right by him, as well as of a benefit to defendant. Plaintiff's original contract was not with defendant, but with Wolf & King. Plaintiff was under no obligation to defendant to perform this contract and we do not wish to be understood as holding that there would not be sufficient consideration for defendant's promise to plaintiff, even though plaintiff was not at liberty to abandon or rescind his contract with Wolf & King, but prefer not to pass on that question."

Construction Industry News

The Chain Belt Co., 766 Park Street, Milwaukee, Wis., has appointed the O. B. Avery Co., 1325 Macklind Avenue, St. Louis, Mo., as distributor of its lines of Rex mixers and pavers, Atlas plaster and mortar mixers, and Durex saw rigs. The Avery organization has recently moved into larger quarters, their new location providing 7500 feet of warehouse space, and a large yard with a private switch and dock with facilities for loading and unloading equipment. This company lately opened an office at Little Rock, Ark.

Lorimer Dunlevy, formerly Sales Manager for the Climax Engineering Co., Clinton, Iowa, has become General Sales Manager for the O. E. Szekely Co. of Holland, Mich., makers of commercial airplane engines and other products now in process of design.

The Eastern Paving Brick Manufacturers Association, Lincoln Building, Philadelphia, Pa., has announced the appointment of Joseph B. Shaw, formerly Deputy City Engineer of Utica, N. Y., as District Engineer for the Association with headquarters at Utica. Walter F. Faber, former General Manager of the Fort Pitt Construction Co., Pittsburgh, Pa., has been appointed Field Engineer of the Western District of the Association with headquarters at Pittsburgh, Pa.

The Truscon Steel Co., Youngstown, Ohio, has announced the appointment of three Vice-presidents. C. I. Auten, who has been with the company for seventeen years, has been named Vice-president in Charge of Sales in the Standard Building Division of the firm. Under his charge will be sales of structural steel, steel-deck roofing and transmission structures. M. T. Clark has been appointed Vice-president in Charge of Sales in the Steel Window Division, with which he has been identified for the last nine years. C. D. Loveland, formerly manager of the Pittsburgh district of the Truscon organization, has been made Vice-president in charge of Truscon distribution in the state of New Jersey, with headquarters at Newark.

The Armco Culvert Manufacturers Association, Middletown, Ohio, has announced the appointment of Harry E. Cotton as Municipal Engineer. Mr. Cotton was formerly Assistant City Engineer of Omaha, Neb. Out of his twenty-two years' engineering experience, nineteen have been in municipal work.

The Barber-Greene Co., 485 West Park Avenue, Aurora, Ill., has recently established a new branch office in Cincinnati, Ohio. This branch is under the supervision of Paul Frederick, District Manager. Mr. Frederick has been with the Barber-Greene Co. for nine years and goes to Cincinnati from the Detroit office, where he had several years' experience as a Sales Engineer. The new address will be Barber-Greene Co., 431 Temple Bar Building, Cincinnati, Ohio.

The Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has recenlty purchased the Monarch Tractors Corporation of Springfield, Ill. In purchasing the tractor company, no change will be made in the name of the corporation. No changes are planned in the general factory and office organizations, R. W. Gotshall continuing as President, and H. B. Baker as Sales Manager. Additional machinery and equipment will be installed in the Springfield plant to provide a considerable increase in the rate of production of finished tractors.

H. C. Beckwith, who has been retired from active business since 1926, has returned to The Byers Machine Co., Ravenna, Ohio, as President and General Manager. L. S. Shaffer is Vice-president and Treasurer, and C. H. Collier, Manager of Sales. This return of Mr. Beckwith, who was formerly General Manager, is in line with the expansion program which has been undertaken since the purchase by Byers of The Massillon Power Shovel Co. of Massillon, Ohio.

The Howard W. Read Corporation, 800 North Delaware Avenue, Philadelphia, Pa., with Howard W. Read as President and Bob Boyer as Secretary, has been organized and among other things has taken over the sale of Jaeger concrete mixers in the Philadelphia territory, succeeding the Lee T. Ward Co. Both Mr. Read and Bob Boyer have been identified in one capacity or another with the construction industry for a great many years.

The Hercules Motors Corporation, Canton, Ohio, advises that on March 7, a frame auxiliary building adjoining the Hercules plant was destroyed by fire. The loss was minor, and operations in the main building, which is of modern fireproof construction, have not been interrupted nor has production been retarded.

The Vergan Schmidt Co., engineers and manufacturers, has announced the removal of its plant to Dubuque, Iowa, from Champaign, Ill.

Gen. R. C. Marshall, Jr., Washington, D. C., war-time chief of army construction, has resigned his position as General Manager of the Associated General Contractors of America, a post which he has held for eight years. Gen. Marshall will become President of the firm of Sumner Sollitt & Co., Chicago, Ill. His successor in the A. G. C. will be D. A. Garber, New York builder and construction expert, who has headed the North-Eastern Construction Co. of New York, since 1904. The change will be effective May 1.

The Sullivan Machinery Co., 162 South Michigan Avenue, Chicago, Ill., has appointed the following new distributors for its line of portable air compressors, drills, concrete breakers, clay spaders and portable hoists, as well as drill sharpening machines and drill steel furnaces: Funkhouser Machinery Co., 2405 Jefferson Avenue, Kansas City, Mo.; C. Taylor Handman, Linwood Avenue, Cincinnati, Ohio; Paul A. Pie, 527 Commercial Trust Building, Philadelphia, Pa.; H. W. Dexter, 22 Laura Street, Jacksonville, Fla.; M. H. Elder Culvert & Machinery Co., Atlanta, Ga.; C. H. Ineson, 116 Exchange Place Building, Rochester, N. Y.; Joseph C. Fiorello Co., 189 Van Rensselaer Street, Buffalo, N. Y.; Staata Abrams, 506 Firemen's Building, Newark, N. J.; and Hunter Machinery Co., 221 South Waterman Avenue, Detroit, Mich.

The Servicised Products Corporation, Chicago, Ill., has doubled its plant capacity over 1927 and has acquired property at New Orleans for the manufacture and distribution of expansion joint at that point. This company manufactures, besides expansion joints, with felt sides, a matted felt fibre core, a cork seal joint and a gray crown joint, as well as bridge flooring, railroad crossing planks, etc.

The Bates Valve Ba gCorporation, 35 East Wacker Drive, Chicago, Ill., has announced the addition to its sales organization of J. I. McCants, who will represent the company in the South, as Southern Sales Manager. Mr. McCants was for many years identified with the cement industry in the South, having acted as General Sales Manager for the old Standard Portland Cement Co., at Birmingham, Ala., for twelve years.

A Pavement Testing Core Drill

A NEW core drill for testing completed pavements has just been produced by the Sullivan Machinery Co., 162 S. Michigan Avenue, Chicago, Ill. It is a compact, rapid, dependable machine for removing cores of concrete pavement, to permit inspection of structure, materials and thickness.

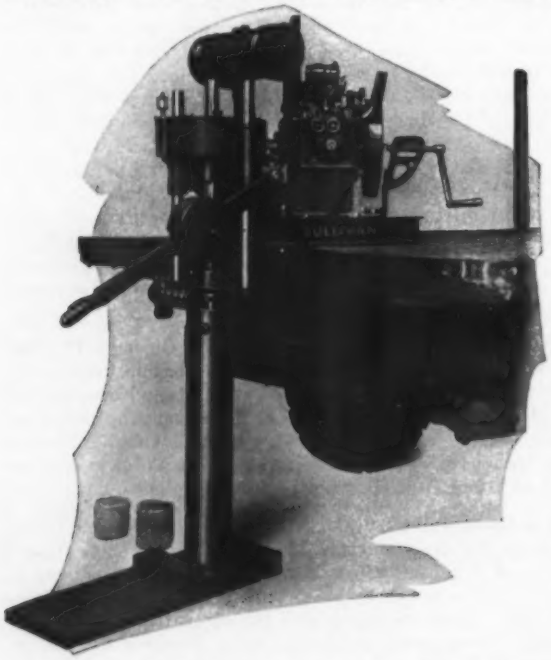
This new drill is operated by a gasoline engine, weighs 772 pounds and is intended to be mounted on the rear end of a motor truck. It drills a 6⅝-inch hole, removing a 6-inch core at the rate of one foot in 15 to 20 minutes. A 7-inch pavement has been penetrated in 9 minutes. This enables it to take from 20 to 30 samples per 8-hour day. With the core barrel usually furnished, this machine will drill to a depth of 18 inches.

The drill consists of a drive rod rotated through bronze worm gears by a direct-connected gasoline engine. The drive rod is kept in alignment by substantial side rods connected to a crosshead at the bottom of the drive rod, and running through cylindrical sleeves which are cast in one piece with the heavy bedplate or frame supporting the drill and engine.

At the lower end of the drive rod is a spider to which the core barrel, 6 inches in diameter, is bolted. The drill is fed downward automatically by means of a double rack cut on the side rods referred to, and double pinions. The speed is controlled by a hand lever which is weighted, the weight being shifted in or out on the lever as desired, so as to secure the proper pressure on the core barrel for drilling.

The crosshead is equipped with a ball bearing which takes both the radial and thrust loads and provides a very rugged and rigid support for the barrel. The drive gears at the top of the drive rod mesh with the drive gear on the end of the shaft of a Buda 6-horsepower, 2-cylinder opposed type, air-cooled engine, and the gears are totally enclosed, running in a bath of oil.

In operation, the outfit is mounted on the rear end of a light truck. In starting the hole, a guide made of plank is laid on the pavement. The operator stands on this board, and the core barrel passes through a hole just large enough to admit it.



The New Sullivan Core Drill in Position for Drilling

Barnes Duplex Model-L 308A Pump with Le Roi Engine

The bottom of the barrel is thus held firmly for starting the hole in the concrete. A small handful of shot, and a pint of water are poured into the core barrel, which is open at the top. The speed of rotation recommended is about 100 r.p.m., although the speed may be varied when desired, by the engine throttle.

Plunger Trench Pumps

PLUNGER trench pumps that handle muddy water, sewage or any liquid thin enough to flow, have been developed by The Barnes Mfg. Co., 905 Main St., Mansfield, Ohio. These pumps have outside packed plungers, enclosed self-oiling steel gears and replaceable shell bearings. Duplex Model-L308A develops 25 to 26 inches vacuum. According to the manufacturers its range of operation is double that of a diaphragm pump, raising the liquid 25 feet by suction and discharging it through a hose or pipe 20 to 30 feet above the outfit.

This pump is driven through steel gears running in oil, which are completely protected by a dust-proof gear case. All bearings are replaceable bronze shells or slip-in bushings. The pump is self priming after being originally started, and is therefore able to keep an excavation dry.

This Duplex pump is especially suited for cofferdam and caisson work, on deep building foundations, sewer jobs and bridge footings where the total head required is beyond the practical limit of a diaphragm pump. It is used with good results on well point or sand point drainage jobs on account of its large plunger displacement and high vacuum. One Duplex pump will handle from 30 to 80 sand points, depending on the soil conditions and the size of points used. This model pump is well able to stand the severe strains of continuous service.

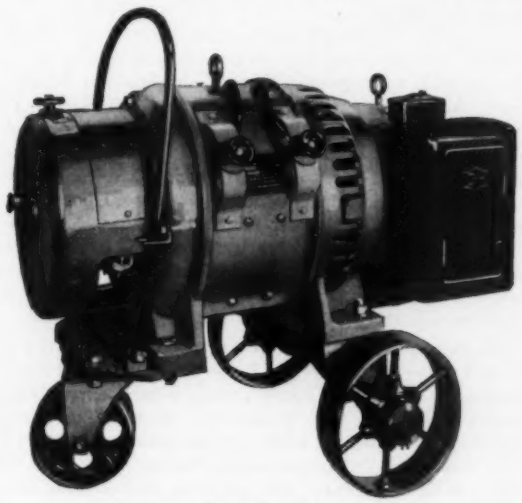
Model-L308A is powered with a 2-cylinder radiator cooled LeRoi power unit capable of developing 7 to 8 horsepower. The capacity of the pump is 12,000 to 18,000 gallons per hour.

While it never will be possible to completely prevent personal accidents in the construction industry, and while it may not be expected that accident records in construction shall be brought down to the level of those in manufacturing, because of the inherently hazardous nature of construction, those conditions do not constitute a reasonable excuse for omitting to do all that can be done in a practical way to reduce the waste and suffering attendant upon accidents.

Flexible Arc Welders

SEVERAL hundred models comprise the line of flexible arc welders of the Fusion Welding Corporation, 103rd Street and Torrence Avenue, Chicago, Ill. This line includes a wide choice of drives and the welders are available in various sizes, and in stationary and portable types.

Inherent stability, without the use of an external stabilizer, is the result of an electrical design in the windings of the generator. A novel disposition is made of the commutating pole windings, the turns of the commutating coils being extended to, and completely embedded in the adjacent main pole flanges. The commutating winding, thus extended and surrounded by laminations, functions in the two-fold capacity of commutating winding and stabilizing winding. Stability is obtained without adding any windings and at the same time the electrical inertia is eliminated. This means that it is practically impossible to change the length of this arc so quickly that it goes out. By adding to the stable arc the possibility of instantly changing its length, a "flexible arc" results.



The Portable Fusion Arc Welder

Another important feature of this arc welder is the elimination of the separate or external exciter. Through an electrical hookup, the excitation required for the generator is taken from the same brushes from which the welding current is drawn. This means that the excitation current really varies with the welding current, and consequently it is substantially equivalent to having an automatic control. By eliminating the exciter and obtaining the excitation current from the main brushes, still more flexibility is added to the arc.

All rheostats, switches, and similar auxiliary apparatus have been eliminated from this arc welder. Because the excitation current is taken off from the main brushes, the current output of the generator can be set at any desired amperage by simply shifting the brushes. A short extension from the brush holder rocker arm passes through the frame of the machine and an attached pointer reads amperes on a legend plate. This legend plate is calibrated to read correctly after the machine has been brought up to temperature by running about one hour. When cold, the machine gives more amperes than indicated. The single control reading directly in amperes makes it unnecessary to purchase meters with the machine. Probably one of the greatest advantages in brush sifting current control lies in the fact that uniform arc flexibility is maintained over the entire range of output of the machine, making it possible to weld from the thinnest to the thickest plates with equal facility.

Since the weld quality depends not only on the generator, but on the operator's technique, the welding rod, etc., the arc welders of this company provide the proper burst of current as the arc is struck to give the desired penetration from the start. This flexible arc is easy to handle and the operator will naturally hold a very short arc and thus produce welds which are not brittle. The welding operator can run an electrode every time without breaking the arc.

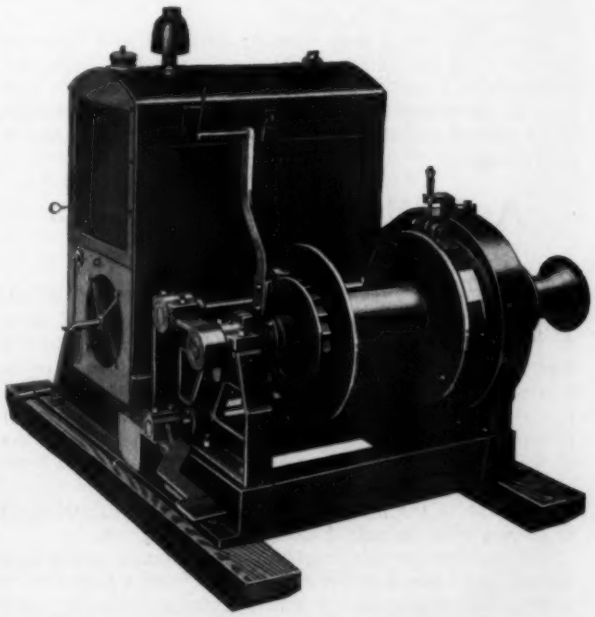
High costs in training welding operators are reduced with this welder, since it permits the novice to melt an entire electrode from end to end the first time he tries, after but a few moments' observation. The welders' rest time need be only half as long as formerly when he was under a rather heavy strain in maintaining the arc and had to rest a great part of the time. The cost of current consumption is said to be reduced with these welders, since, through the elimination of the external stabilizers, etc., the voltage drop through such apparatus is eliminated, with a resultant saving of 10 to 50 per cent in power required to operate the set.

This welder not only can be used for hand or automatically operated metallic arc welding, but also with equal facility for carbon arc welding and cutting. Two or more welders can be readily connected together and run in parallel, giving as many times the current output as there are units connected into the one battery. The welder can operate at greater distances from his generator with this arc welder.

A Small, High Speed Hoist

A NEW Model 15-S high speed hoist has been developed recently by The Brown Clutch Co., Sandusky, Ohio, primarily for the smaller operators and for the innumerable little jobs on every big project. This hoist is featured as a quality product designed to stand up under continued high speed operation in a 1500-pound hoist, 200 feet per minute, providing the same saving of time on comparatively light work as has heretofore been possible in the larger units.

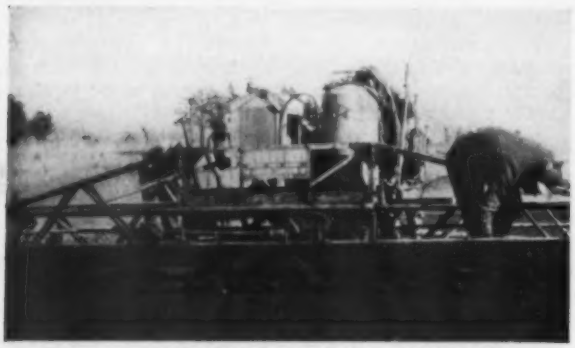
The Model 15-S is equipped with the 4-cylinder, 12-horsepower Le Roi radiator-cooled power unit, providing a liberal reserve or surplus over and above its rating, insuring long continued service. A double-drum unit can be attached in the field at any time.



Model 15-S High Speed Hoist With Le Roi Power Unit

Contractor Uses Finishing Machine for Asphalt Pavement

A SUBSTANTIAL saving in labor was accomplished by the H. L. Cannady Co., of Tulsa, Okla., when they used their Lakewood Type "C" screed finishing machine for the spreading of asphalt surface. This was a standard machine which had originally been used to screed and tamp the concrete base on which the asphalt top was to be



A Lakewood Road Finisher Working on Asphalt

placed. The tamper was not used for the asphalt, the screed member alone being employed to spread, compress, and surface the top.

The contractor reports that not only did he eliminate the necessity for expert hand rakers, and reduce materially the number of men required for spreading, but he also increased his daily production with the machine by more than 50 per cent over what he had been getting by hand work. He also obtained a smoother riding surface.

The machine travels on the concrete curb; no other side forms are required. The heat of the material keeps the steel screed member hot enough to prevent sticking when the machine is operating. In the morning, before starting work, the screed was given a preliminary heating with a kerosene torch. This was necessary on account of the fact that the temperature averaged around 34 degrees.

The savings which have been accomplished with machines for this work are so substantial that it seems probable that there will be a considerably greater use of them for this purpose as the contractor becomes familiar with the economies to be effected and the ease with which a smooth surface can be obtained.

A Full-revolving, All-purpose Shovel

AN all-purpose, one-man ⅝-yard gas shovel, that is full-revolving, has been produced by The Byers Machine Co., Ravenna, Ohio. It is the "Whirly" Model-128 Bear Cat. The main frame of this new unit is a single open-hearth steel casting, assuring ample resistance to the maximum strains received in service. Another unit casting, 58 inches in diameter, provides the ring gear and rotating track. Shoulders of the gear are accurately machined to furnish an even bearing. The extra wide bearing which at four points attaches the main frame to the heavy channel frames of the crawlers, is in keeping with the rugged construction throughout.

The crawlers on this machine are 10 feet 8 inches long overall, and 8 feet 3 inches outside width, with a height of 33 inches. The crawler shoes are 16½ inches wide, of the closed surface type, providing a light unit area pressure.

Two speeds on the shovel give a low travel rate of ¾ mile per hour and a high travel rate of 1½ miles per hour. The steering control is positive right or left, and combines with a brake control which locks either crawler or both of them when the machine is in operation. Control is simple and easily handled by the operator with the cab in any position, according to the manufacturer.

The turntable on which all the machinery is mounted is designed to stand the heaviest stresses. It is a heavily webbed, open-hearth steel casting. An 8-inch center pin prevents any tipping or rocking of the turntable. Side machinery frames are also extra heavy casting with wide and long base. The hoist drum shaft, swing shaft, and crowding shaft bearing caps are all interchangeable and provided with large cap bolts.

Four rollers, 10 inches in diameter with 3-inch face, insure smooth revolving motion of the turntable. These rollers can be readily removed for repair or replacement without jacking up the turntable.

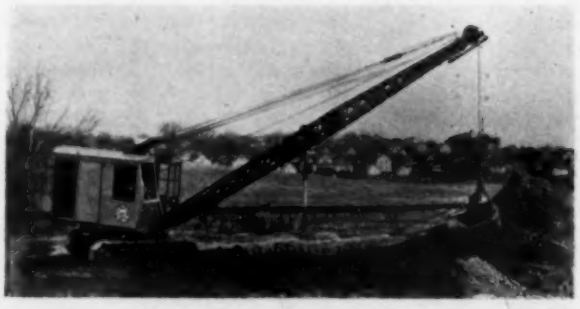
The number of moving parts in this shovel has been greatly reduced. One shaft carries both main drums, another the transmission with spur gears, reversing clutches and boom hoist drum. The crowd drum is reversible and actuated by a spur gear on the transmission shaft. All friction clutches are of the internal expansion balanced type, requiring minimum effort on the operator's part to set or hold them in place.

A Hercules 4¾ x 5¾ motor, developing 52 horsepower at 1,100 r.p.m., furnishes power for all operations. The take-off is through a Twin-Disc clutch by an automatically lubricated silent chain belt to the transmission shaft. A large opening in the machinery base permits easy dropping of the engine oil pan for quick repairs.

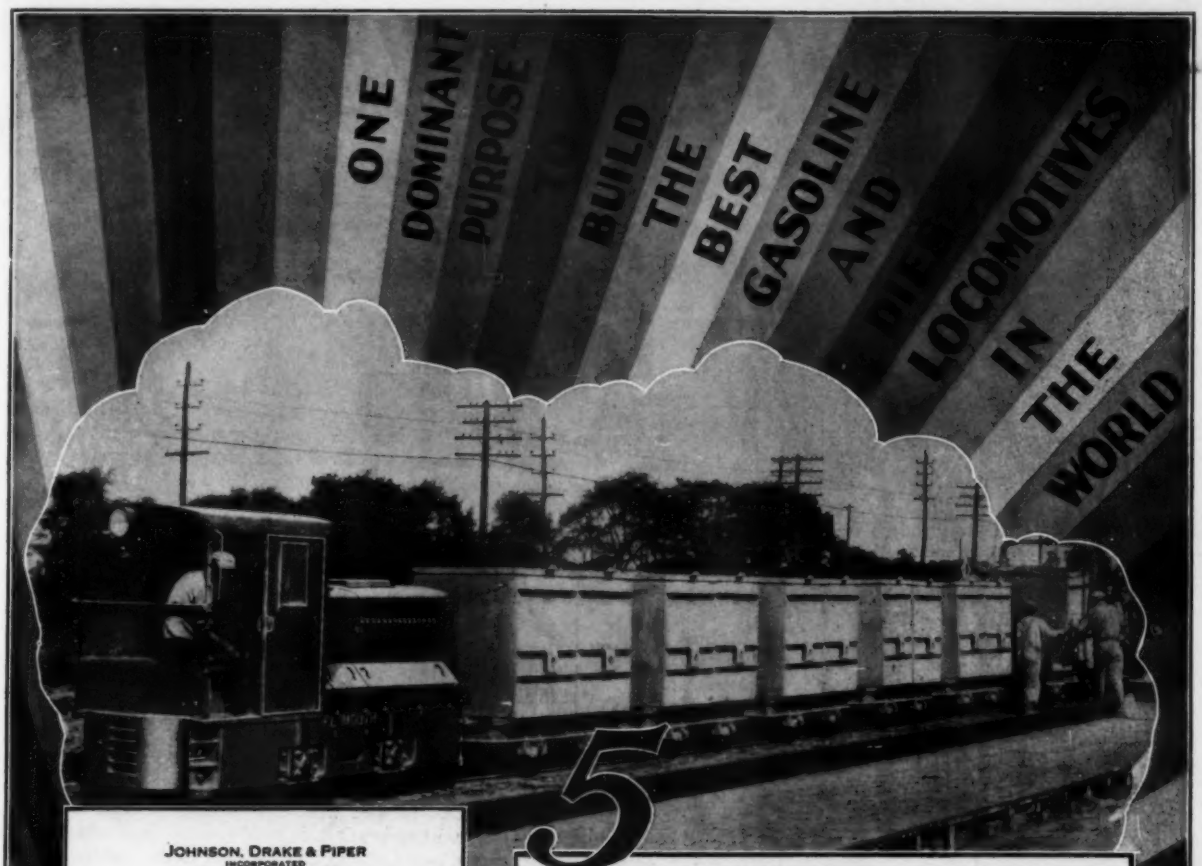
Patented spring-mounted sheaves at the foot of the boom handle a ¾-inch steel center cable so as to give only a minimum amount of wear. A 35-foot lattice type boom is standard equipment for use with a clamshell, and the machine will handle a ⅝-yard bucket with ease and speed. With this same boom, fair lead and proper drum lagging, this Bear Cat is converted to a dragline. For skimming and ditching the new model need only be equipped with the Byers gallows frame, special boom and attachment for the job.

In order to provide a maximum working area for this machine, an 18-foot boom and 14-foot dipper stick have been used. White oak timbers, reinforced with steel plate armors and bar steel, make up the boom. Two extra heavy annealed steel castings, bolted at the lower end, allow for timber shrinkage. Being narrow at the bottom end, the boom does not interfere with the operator's vision of the job.

The boom point sheaves are annealed cast steel, bronze bushed, and interchangeable with padlock sheave. The shipper shaft is of alloy steel, with large bearings mounted on top of the boom for easy removal. The stick is double timbered, of seasoned white oak, reinforced with steel and tied at the top to prevent spreading. A worm locking drum at the tip provides a positive and immediate take-up for the crowd cable. The stick is always held in line by a cast steel yoke block and a steel track running on flanged rollers on the shipper shaft.



The Byers Bear Cat "Whirly"



JOHNSON, DRAKE & PIPER
INCORPORATED
GENERAL CONTRACTORS
MINNEAPOLIS

February 29, 1928

The Fate-Root-Heath Company,
Plymouth, Ohio.
Gentlemen:

On the construction of the Conduit Boulevard, between Rosedale and Amityville, Long Island, we have been keeping two 27E Mixers working to capacity with our five 8-ton Plymouth locomotives.

One of these locomotives is being used as a yard switch engine making up trains, the other four handling twelve to fourteen loaded cars per trip on a maximum haul of 2 1/2 miles. Our heaviest grade is 2 per cent and the locomotives have no difficulty in handling 600 tons of material a day, with a maximum gasoline consumption of twenty gallons for an eleven hour day.

Very truly yours.
JOHNSON, DRAKE & PIPER, INC.

By

5

PLYMOUTHS Keep the Mixers Busy

For Johnson, Drake & Piper, Inc. on the construction of the Conduit Boulevard, between Rosedale and Amityville, Nassau County, Long Island.

Keeping the mixers busy—that's real satisfaction—it's more than satisfaction, it's the key to profits. There is no better insurance against wet season losses than track haulage and Plymouths.

If you have a long paving job or an important time limit contract, now is the time to check into track haulage and its advantages—Why gamble the profits of a good contract on uncertain weather?

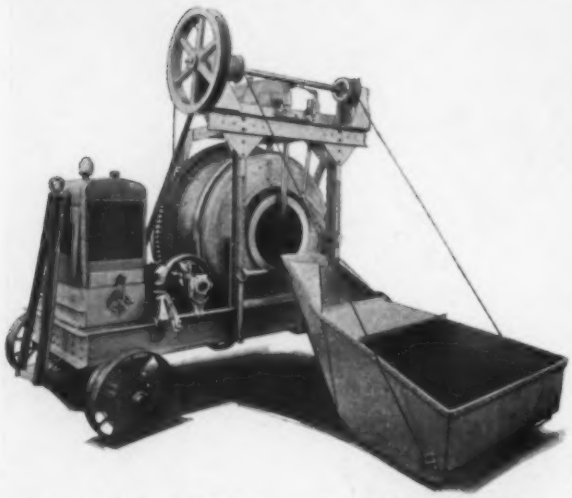
Steel rails and sturdy Plymouths running faithfully to the mixers give you that grand and glorious feeling—especially in soggy weather.

PLYMOUTH LOCOMOTIVE WORKS
The Fate-Root-Heath Company
PLYMOUTH, OHIO

GASOLINE PLYMOUTH LOCOMOTIVES DIESEL

PLYMOUTH

GASOLINE *Locomotives* DIESEL



The Skip Side of the New Ransome 14-*S Building Mixer*

A New 3-bagger

SIMPLICITY is the oustanding feature of the new 14-S standard building mixer of the Ransome Concrete Machinery Co., Dunellen, N. J., which is capable of handling a 3-bag batch of 1:2½:4 concrete. All parts are very accessible and easily replaced.

The drum of this mixer is 57 inches x 42 inches, with large radius corners. The feed and discharge openings are 22 inches. The countershaft is of high carbon steel running in Hyatt roller bearings in self-aligning boxes. The gears are cut and running in a bath of oil. The lubrication is Alemite.

The truck is the automotive type, with front axle. The main rollers are genuine car wheels with Timken roller bearings running on alloy steel shafts. The traction rings are one-piece forged, high carbon, locomotive steel tires.

The power loader takes a full load without crowding and goes up in seven seconds. There is an automatic knockout on the power loader. The overhead shaft is carried in self-aligning boxes. The mixer is self-sustaining with the power loader. No braces are required.

All control levers are at the drum end, and the operator can see both power loader and discharge. Gasoline, electric or steam power is furnished, as required.

A Winch for Pulling Out Mired Trucks

A WINCH which applies to the rear axle of a motor truck and operates without jacking up the rear wheel, is being manufactured by the Braden Steel & Winch Co., Tulsa, Okla. This is of particular advantage to contractors whose trucks frequently get into difficulties on construction projects. Because of its unique location, the winch is entirely out of the way. It is light in proportion to its use, adding little to the weight of the truck. The winch is made in approximately twenty-five types, which apply to over 500 models of trucks.

The winch that is especially suited for this work of pulling trucks out of mud and sand holes is the Braden winch. Among its features are: accessibility of the winch head regardless of the condition of the load or truck body design; variable speeds corresponding to any transmission speed, forward or reverse; adaptability to 90 per cent of the loading, pulling, and hoisting requirements of industry, and versatility.

The principle of operation of this mechanism is the disengaging of the axle drive shaft from the wheel and engaging the shaft to the rotatably mounted driven member of the winch. Since the wheel is disengaged from the torque action of the rear axle, in case the axle shaft is caused to rotate, such rotation would have no effect on the rear wheel which would then be only a "leg" or means of holding up or carrying the load.

The method of operation of this winch is easily understood. The sliding clutch on the outer side of the rear axle is shifted by means of a screw, so that its teeth engage either with those in the winch drum or with those on the hub of the wheel. When set for driving the winch, the rear wheel is disengaged from the axle and remains stationary. It is not jacked up. The motor's power is transmitted direct to the winch drum. When the clutch is set for driving the wheel, the winch drum becomes a rigidly connected part of the wheel and rotates with the wheel.

With the winch line attached to a tree or other stationary object, and on a straight line pull, the load is pulled through mud. This does not injure the truck in any way, for the pull is constant and is taken through the rear axle assembly into the frame and the truck moves forward regardless of the depth of the mud.

The screw which accomplishes the shifting of the clutch from one position to the other is inserted through the outer cover in such a way that it is convenient to apply a special speed wrench to a hexagonically shaped driver on the outer side of the cover. The shifting or operating screw is made of alloyed steel having a USS No. 10 right hand thread. The screw rotating clockwise and being in engagement with the threaded center portion of the sliding clutch, the clutch will be drawn outward. In this operation the clutch is disengaged from the hub and engaged with the rotatably mounted head. The sliding clutch is returned to engagement with the hub by a counter clockwise rotation of the screw.

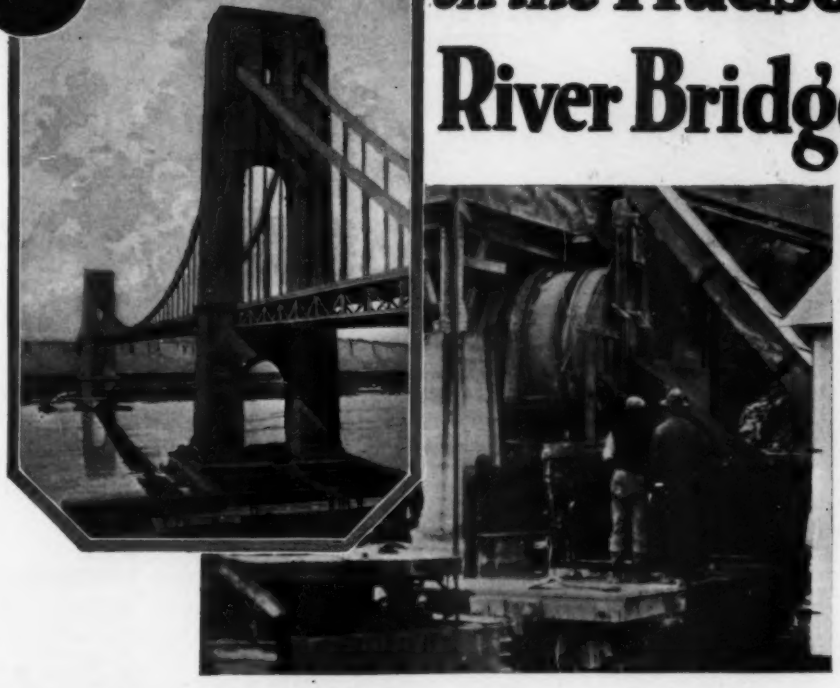
The winch used for this work has only one bearing in full-floating jobs, and two bearings in semi-floating jobs, which are Timken tapered roller bearings, in addition to the regular bearing equipment. The other bearing has a reciprocating oil groove which insures constant lubrication. The winch operates without any attention when the winch clutch has been shifted by the operating wrench.

The Braden Winch Used For Pulling a Mack A B-Model Truck, Owned by the Sinclair Oil Co., at Seminole, Okla., Out of the Mud. The Load Weighs Approximately 11,000 *Pounds*

Public Works to Aid Employment

THE considerable amount of unemployment in the State of Pennsylvania has brought forth from Samuel Eckels, Chief Engineer of the Department of Highways at Harrisburg, Pa., an announcement that it is good public policy to put public improvements underway at this time so as to relieve the situation. The Department expects the cooperation of all of its contractors to the extent of employing the citizens of the State of Pennsylvania, which is paying the bills, rather than importing cheap labor from outside sources.

Ransome on the Hudson River Bridge



The Ransome 56-Mixer used on the Hudson River Bridge by the Silas B. Mason Co.

General statements about the 56-S are easy to make, but they do not satisfy a contractor like real PERFORMANCE FACTS, such as the following:

SPEED— Large, round batch hopper openings and space in the rear of the drum give quick feed. The speed of Ransome mixing action is well known. 10 to 12 seconds to discharge. The instant the discharge is completed, the batch hopper gate can be opened, and it is practical to open it earlier than this. Produces an average of 40 batches per hour, allowing a full minute mix.

ENDURANCE— Its few working parts and sturdy construction give unusual endurance. In industrial plants, they have been in practically continuous operation for years. Two Ransome 56-S mixers mixed over 400,000 cu. yards on the Hetch-Hetchy Dam, and two more nearly this amount for the Alabama Power Co.

ECONOMICAL INSTALLATION—The mixer is very compact. The distance from the point of discharge to the top of the batch hopper is 6 ft. 4 in. A saving in the heights of overhead bins and on every ton of material raised to the top of the bins.

Write for Bulletin

RANSOME DOMESTIC REPRESENTATIVES

ALBANY, N. Y.
Roger-Smock Supply Co., Inc.
ASHEVILLE, N. C.
Sutton-Osborne Supply Co.
ASTATULA, FLA.
Prescott Machinery Co.
ATLANTA, GA.
Williams-Small M'chy Co.
B. F. Avery
BALTIMORE, MD
Giles & Ransome
BIRMINGHAM, ALA.
Smith-Meadow Supply Co.
BOSTON, MASS.
Clark-Wilcox Co.
BUFFALO, N. Y.
The Wheeler-Murray Co.
BUTTE, MONTANA
Western Supply Co.
CLARKSBURG, W. VA.
Clarksburg Supply & Equipment Co.
CHARLOTTE, N. C.
W. Fred Carey and Co.
CHATTANOOGA, TENN.
Brown Craven Equipment Co.
CHICAGO, ILL.
Ransome Concrete Machinery Co.
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The C. Taylor Henderson Co.
CLEVELAND, OHIO
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Construction Equipment Co.
DALLAS, TEXAS
J. W. Barthelow Co.
DAVENPORT, IOWA
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LOS ANGELES, CAL.
Enrich & Co.
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MINNEAPOLIS, MINN.
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Fitzgerald & Hudson
NORTHPORT, N. Y.
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OKLAHOMA CITY, OKLA.
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PHILADELPHIA, PA.
Giles & Ransome
PITTSBURGH, PA.
Ransome Machinery Co.
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Clare Osborn, Ltd.
VANCOUVER, B. C.
B. C. Equipment Co.

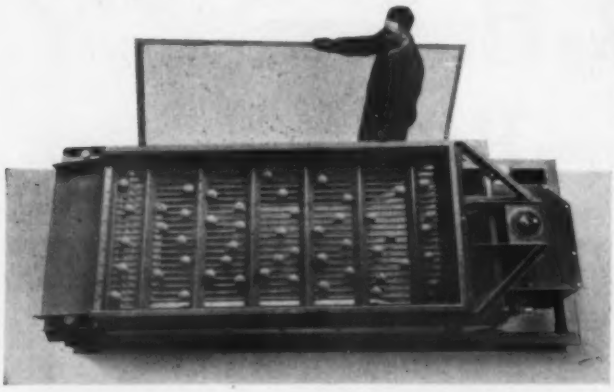
Ransome Concrete Machinery Company

1850—Service for 78 Years—1928

Dunellen **New Jersey**

A Heavy-duty Screen

DESIGNED originally for the hard service encountered in pit, mine and quarry work, the heavy-duty screen of The Orville Simpson Co., 1230 Knowlton Street, Cincinnati, Ohio, is adaptable to less severe operations and is frequently preferred on account of the larger screen surfaces obtainable. The main feature of this screen is an all-steel screen box with a screen stretching feature.



Rotex Screen No. 14, *Showing Rubber Ball Mesh Cleaners*

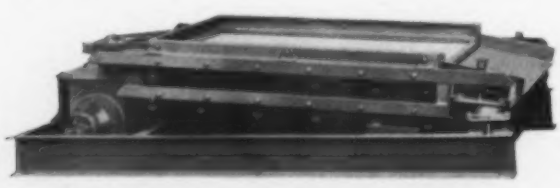
The meshes used in this screen are from 1¼-inch down to the finest. The nearly level gyratory screen motion gives numerous advantages. This is the same level action that is used in the laboratory testing sieve, and like the testing sieve, a mesh opening is used which actually represents the division between the sizes wanted, and which permits the passing of as much of the minus product as is mechanically possible, while withholding all of the oversize material from the "throughs." No plus size goes through.

In this Rotex screen there is a 3½-inch level, circular motion, with a normal screen inclination of only 4 degrees, but this angularity is sufficient to cause the material to slide forward rapidly at each outward stroke, and pass with all the speed necessary to the discharge end. This circular motion, at the rate of 215 gyrations per minute, not only spreads the material quickly across the screen, but also stratifies the coarse and fine particles, causing the "fines" to sink down where they are in position to go through the screen unobstructed by the coarse particles which ride along on top of the stream of material.

The double opposed balance wheel system for absorbing vibration is used. This has balance wheels revolving in opposite directions, and has a large weight in one wheel and a small weight in the other, making possible a good balance of the machine, even where the moving weight of the screen box is as great as 1300 pounds.

The No. 14 screen of this company has a screen surface 4 x 8 feet, the height from the bottom of the base to the screen surface at the head end being but 26 inches. Spouting to and away from the screen is made easier on this account. No space beyond the discharge end need be provided for drawing the screen cloth out endways, as all screens can be taken out at either side.

These screens incorporate the Rotex mesh cleaning system which might be likened to the effect produced by a large number of rubber mallets striking at random against the entire under surface of the screen cloth. Fifty 3-inch diameter, solid rubber balls shake the material from between the meshes, and knock particles loose by actual contact, and by compression and suction against the mesh openings.



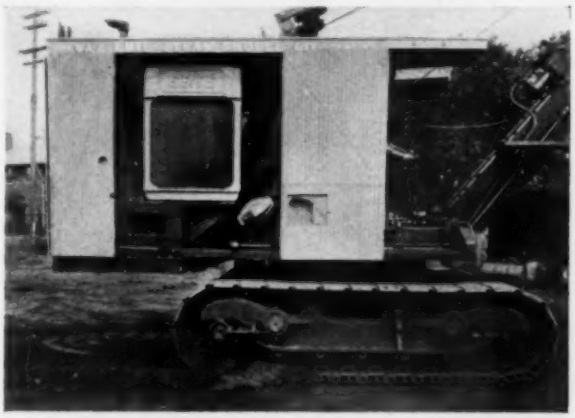
Two-deck Rotex Screen for Dual Separation

These screens are built for hard, continuous usage. Chrome nickel steel of 111,000 pounds tensile strength to the square inch is used in the main crank shaft. There are six S.K.F. annular ball bearings and three S.K.F. self-aligning bearings with a crank roller bearing having a load carrying capacity of over six tons at normal working speed. There are no parts revolving or pivoting in plain bearings. The driving mechanism at the head end is enclosed in a dust-tight box which is built of welded steel plate.

A Single-shaft Drive Crawler Mounting

A SINGLE-SHAFT drive crawler-type mounting for shovels and cranes has been produced by the Bucyrus-Erie Co., Erie, Pa. Fewer parts, giving extra strength, and other features mark this new type of equipment.

The single-shaft drive mounting is non-clogging. Even when it is shoveled full of dirt, it throws out the material as it moves ahead its own length. It takes grades of 30 per cent and steeper. The drive chains are of hardened forged steel. A 2-way brake, which operates with a ratchet effect, allows free movement in either direction as desired, but locks the machine against the digging, or on a grade. Sharp turns can be made with this mounting, as well as gradual turns. It can make either a right angle turn in one spot, or a long radius



Bucyrus-Erie Shovel, Showing the Crawler Tread Cleaning Itself of Coarse Cinders

turn—steering from either end of the treads, with the machine moving either forward or backward.

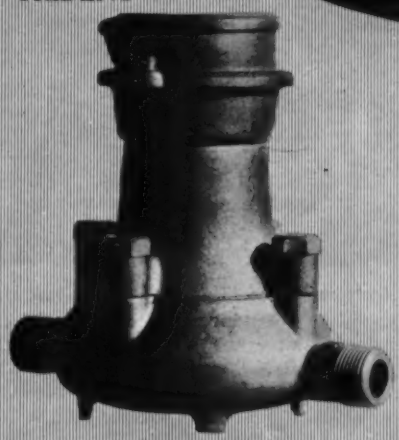
Another feature of this mounting is its easy accessibility for renewing or inspecting parts. Any wearing part can be quickly and easily removed without disturbing any other part. Great simplicity is possible by the single shaft and gear below the deck. The one gear and its pinion are enclosed, protected against dirt and grit, and operate high above the ground. There is a 12-inch clearance underneath, and nothing to drag when moving over rough uneven ground.

The truck frame is a one-piece annealed steel casting, 23 inches deep, that is durable and built for continuous service. The drive shaft is splined, and has no keys. The treads are strong, and have 1½-inch hardened steel pins.

This mounting is now furnished as standard equipment on all Gas + Air and B-2 steam Bucyrus-Erie machines.

ACCURACY

TRIDENT



LAMBERT

—in manufacture
—in registration

Accuracy of every part—accuracy measured in thousandths of an inch—is the dominating characteristic of every Trident Meter. Forthcoming advertisements will illustrate photographically and describe how this accuracy is attained, in every step of manufacture, from initial mix of metals to final testing and shipment check-up. They will tell the "reasons-why" behind Trident interchangeability, and sustained accuracy of registration after years of continuous operation.

Of TRIDENT and LAMBERT Meters, well over 4,500,000 have been made and sold the world over. They embody every pioneering improvement in water meter design.

Pioneers in Meter Progress
Yesterday TODAY Tomorrow

NEPTUNE METER COMPANY
THOMSON METER CORP.
50 East 42nd St., New York City

"The Cash Registers of the Water Works Field"

A Labor-saving Combination of Concrete Mixer and Conveyor

Paver Used With Portable Conveyor

AN ingenious arrangement of a concrete road paver and a portable belt conveyor was used in California recently for placing concrete on the Los Angeles County flood control work in the Verdugo Wash. Approximately 45 tons of material were poured per hour, using only the two pieces of equipment.

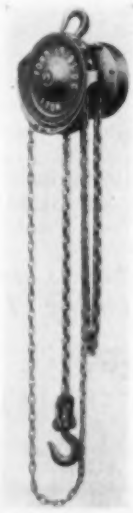
In doing the work, the floor of a concrete-lined channel, 3400 feet long and 47½ feet wide, was first laid, using a MultiFoote 27-E paver. As the work progressed, the reinforcements were placed and the forms set in position for the 8-foot perpendicular side walls. After the floor was finished, a portable conveyor was hooked up to the paver, and a large hopper was installed at the lower end of the conveyor. The concrete from the mixer was discharged directly into this hopper. Six-inch slump concrete was then conveyed directly from the paver into the wall form by means of the conveyor. This arrangement worked steadily at maximum capacity without trouble and eliminated the need for wheelbarrows, carts, chutes, hoists, and other equipment usually used on jobs of this sort. The conveyor was trailed by the paver in changing position, and the combination of paver and conveyor was both mixing and delivering plant.

Several years ago the contractors, the Roche Axman Co., developed this idea on a similar contract in Utah. It worked so efficiently it has been used on all of their jobs of this kind. The flood control work for Verdugo Wash was designed under the direction of E. C. Eaton, Chief Engineer, and S. M. Fisher, Designing Engineer of the California Flood Control Department.

A Chain for Heavy Loads

A HIGH carbon, electrically welded chain for the Ford Tribloc has been produced by the Ford Chain Block Co., 2nd and Diamond Streets, Philadelphia, Pa. It has great strength, maximum ability to withstand wear, and will not stretch under heavy loads.

Every link in this chain is proof tested with special instruments and when the chain is assembled it is again tested. It must show an overload of 50 per cent above its rated capacity. The chain hoists are built in capacities from ¼-ton to 20 tons.



A Heavy-duty Chain for the Ford Tribloc Hoist

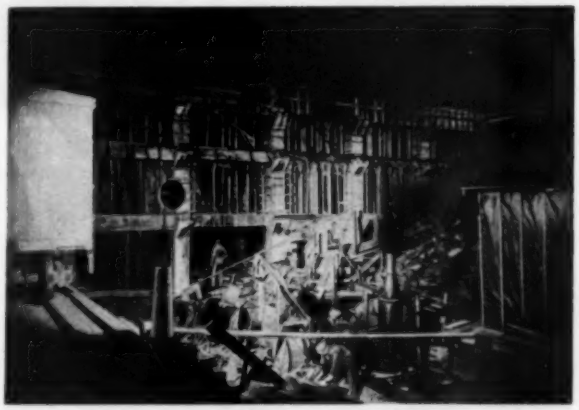
A Portable Lighting Unit

A PORTABLE acetylene flare light that is extremely powerful has been added to the line of the Oxweld Acetylene Co., 30 East 42nd Street, New York. This flare light is manufactured by the American Carbolite Co., Inc., Duluth, Minn. This flare light operates under all climatic and weather conditions. It is equipped with a storm-proof burner, permitting its use even in the most violent storms.

The fuel used is acetylene, produced from Carbic. This material is in the form of cakes of uniform size and cylindrical shape. Several cakes, enough to operate the flare continuously for twelve hours, can be placed in the light at one charging. If the use of the light is discontinued before the entire charge is used, the portion remaining can be left in the holder, or being dry, solid and clean, can be slipped back into the drum for later use.

There are only three parts in this unit, making for rugged and simple construction. Charging requires but a few minutes, and, when put into operation, the light requires no further attention until the charge is exhausted.

An automatic feed allows water to come into contact with the lowest cake of Carbic until sufficient acetylene is generated to drive the water out of the gas bell to a level below the bottom of the cake. This process is continually repeated during the operation of the light, and gas generation is uniformly and safely maintained at a pressure of less than one pound per square inch.



The Portable Acetylene Flare Light for Night Construction

Should the light be accidentally upset, the water runs out of the container and gas generation stops immediately.

The Carbic light is available in several styles, each of which is self-contained. It ranges in size from the 8,000-candlepower "Standard" model which weighs 36 pounds empty and 115 pounds charged and stands 6 feet 7 inches high with reflector raised, to a hand light. A double burner model, which will furnish illumination in two directions simultaneously, is furnished in about the same size as the "Standard" model.

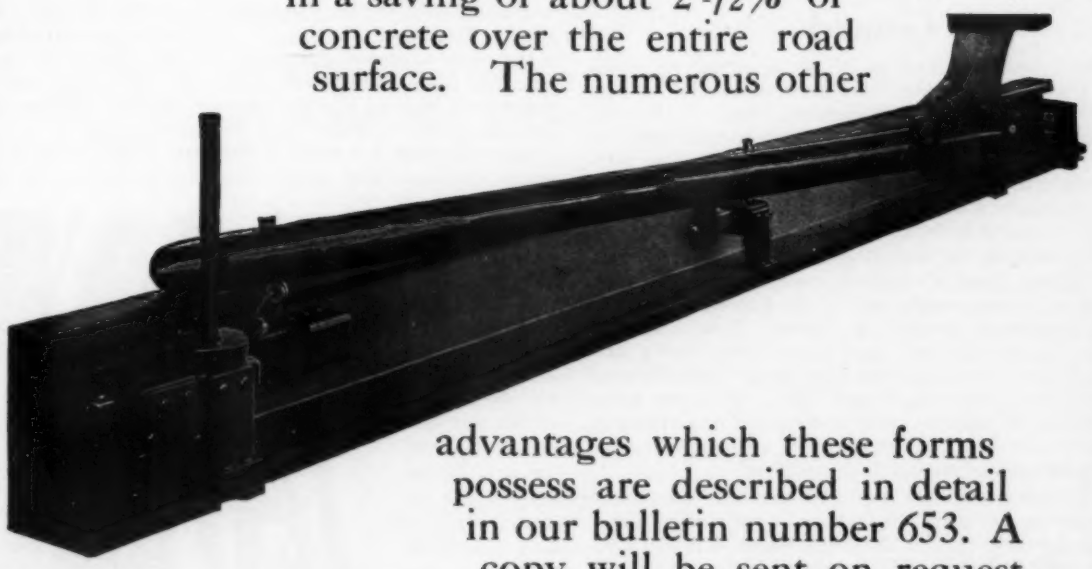
Paving Brick Simplified Practice Reaffirmed

AT the annual meeting held March 22, at the Department of Commerce, Washington, D. C., the Standing Committee for Simplified Practice Recommendation No. 1—Paving Brick, reaffirmed without change the existing simplified practice recommendation on paving brick for another year. This recommendation, which eliminated 93 per cent of the varieties of the commodity, was originally promulgated in 1921. The committee reported that the average degree of adherence to the recommendation was 79.6 per cent for the year 1927. G. F. Schlesinger, Director of Street Highway, Columbus, Ohio, was elected chairman of the committee.

TRUSCON STEEL ROAD FORMS

SAVE CONCRETE!

All Truscon Steel Road Forms are thrown down 1/8″ in 2″ on the outside head of the rail, which conforms with a 3″ crown of road. With this arrangement, striking off is done on the inside of the Road Form instead of the outside, resulting in a saving of about 2 1/2% of concrete over the entire road surface. The numerous other



advantages which these forms possess are described in detail in our bulletin number 653. A copy will be sent on request.

TRUSCON STEEL COMPANY, YOUNGSTOWN, OHIO

Manufacturers of a complete line of Reinforcing Products for Concrete roads and pavements—Welded Steel Fabric for permanence; Contraction Joints for the elimination of cracks; Rib Bars for supplementary reinforcing; Curb Bars for concrete curb protection; Steel Road Forms for economical construction.

Opening a Bale of Page Wire Fence

A New Type of Highway Guard

A NEW type of highway guard that is a tough yet elastic fabric of woven wire, has been developed by the Page Steel and Wire Co., Bridgeport, Conn. It is called "The Life Line of the Highway," and when hit hard, stretches, holding the vehicle securely, with a minimum amount of damage. Only after the most severe impacts is it necessary to repair this guard. A new section can be inserted in a few minutes. It is repaired in the same manner as the fabric is woven, the guard becoming the same as originally.

This highway guard is similar in construction to the chain link style of fencing widely used in the industrial field. Its main features are its strength and elasticity. Each square foot of fabric contains thirty-six small squares formed with fourteen interlocking steel wires, each wire having a tensile strength of 60,000 pounds per square inch. This square flat weave makes the guard easier to erect, easier to get into alignment, less deformation after the impact, more easily repaired, and there are no torsional stresses from stretching.

Copper-bearing steel, well known for its rust-resisting qualities, is used in this guard. It is made in one standard size—the mesh is 2 inches square, the wire is 6-gage W & M (.192), and the width 24 inches. The pickets are so formed that the mesh is exactly square. They are woven with flat loops. Each picket of the fabric is knuckled (has the ends looped together) at top and bottom.

After the fabric is woven, it is hot galvanized. This coating of zinc is evenly applied and of uniform thickness. It gives the fabric a light color which makes it highly visible day or night, and, in addition, affords the utmost protection against corrosion.

Ease of installation is a feature as with a few tools, two men can erect several thousand feet in one day.

A 5-ton Hoist That Weighs 110 Pounds

A GENERAL utility all-steel hand hoist that is built of high grade electric steel, is practically indestructible, compact, and simple, has been developed by Beebe Bros., 3219 First Avenue, South, Seattle, Wash. This hoist has a capacity of 5 tons straight line, and has two quickly shifted main speeds and instantly adjustable handle, giving a maximum range of speed and power to conform to various loads. This B. B. Bros. hoist weighs but 110 pounds.

The hoist lends itself to many unusual performances. The accompanying photograph shows two Beebe all steel hand hoists placing one of the nine 66-inch high-pressure valves, weighing 21 tons each, that were installed by the City of Seattle, Wash., Lake Young Water Project. The hoists had 4-part lines and were installed on a stradled gantry frame work on skids. The gantry was placed over the valves on rollers, valves were lifted and the entire unit was rolled into place.

The hoist has a positive cam-action internal brake, and spring-operated safety dog equipped with a positive lock-out lug. It can be bolted anywhere and operates in any position. Because of its simplicity of operation and control, it is suitable for all purposes where a heavy lift or pull is needed by hand power, and also meets the requirements for the many out-of-the-way, or intermittent lifts or pulls where power is not practical or available.

There are no keys, set screws or pins to strip. The internal gear and extended drum shafts are made as part of the drum, these shafts being machined to 2-inch diameter and operating in heavy-duty anti-friction Babbitt bearings in the steel side frames. There are no exposed gears on the drum to foul the cable. The external gear, with machined internal brake drum, together with drive shaft and internal pinion are also made of one piece of steel.

The crank pinion and shaft are of one piece of steel, attached to a steel handle, instantly adjustable from 12 to 18 inches in length. This pinion and shaft fit into a counter-sunk recess in the center of the external gear when a gear ratio of 4:1 for rapid lift up to 1500 pounds is desired. When this crank pinion shaft is placed into the lower steel bearing, a compound gear ratio of 24:1 is obtained for loads up to 5 tons.

The cable drum is 5 inches in diameter, 8 inches wide with flanges 3½ inches deep, giving a capacity of 160 feet of ⅝-inch cable.

The steel brake of the hoist is lined with high grade wire inserted brake lining, engaging the internal rim of the outside gear, giving a 4:1 braking ratio on the drum and is operated with a steel cam lever easily controlled to any desired break pressure; a brake strong enough to hold or lower a 5-ton load, and will remain permanently locked when set until released.

The Beebe Hand Hoist Moving a 21-ton High Pressure Valve at Seattle, Wash.

"Ground-Floor" Experience in Low-Cost Construction

Low-cost construction?

Tarvia was in on the ground floor of that job. Methods worked out with Tarvia put low-cost improved roads on the map—and kept them there.

Ask highway officials who have made use of Tarvia service. They'll tell you—

—that Barrett's 23 years of experience in low-cost construction has been a big help in working out their programs.

—that, because of that experience, Barrett field men know the answer to just about every question relating to the construction, repair and maintenance of low-cost roads.

Let us know when it will be convenient for a Tarvia field man to call at your office.

Tarvia
For Road Construction Repair and Maintenance

The Barrett Company

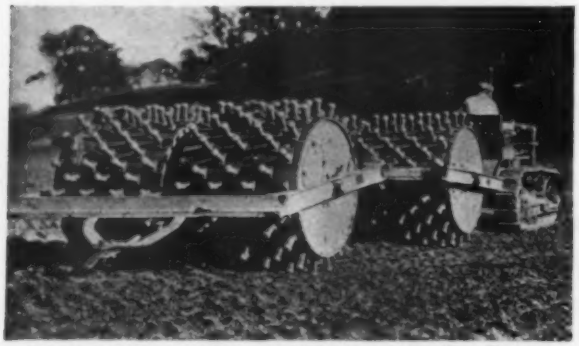
New York	Chicago	Minneapolis	Cleveland	Philadelphia	Birmingham	Boston
St. Louis	Salt Lake City	Syracuse	Providence	Buffalo	Bethlehem	Kansas City
Detroit	Milwaukee	Baltimore	Toledo	Cincinnati	Lebanon	Columbus
Youngstown						Rochester

In Canada:
THE BARRETT COMPANY, Limited: Montreal, Toronto, Winnipeg, Vancouver

A Tamping Roller

IN constructing the earth-filled dam in the Pudding Stone Reservoir Project, for the Los Angeles County Flood Control program in California, the contractor, H. W. Rohl & Co., of Los Angeles, used a roller manufactured by the Western Pipe & Steel Co., Los Angeles, Calif., from specification prepared by H. W. Rohl. It is 5 feet 3 inches high, 9 feet 1 inch wide, and 14 feet long, and is sold by The Brown Bevis Co., 470 East Third Street, Los Angeles, Calif.

This Rohl tamper, as it is named, consists of two rollers, 48¼ inches in diameter and 4 feet long. These rollers are made of steel plate ¾-inch thick. Each roller has 119 cast iron tamper feet with ball-shaped heads. These balls, with the rotation of the cylinders, produce a compacted surface. The tamper feet are staggered so that a uniform distance of 8 inches between the tamper feet is secured. They are securely bolted to the steel rollers by bolts measuring ⅞-inch in diameter and are securely attached so that the feet cannot work loose or turn. These tamper feet imitate the feet of a flock of sheep noted for their tamping ability when passing over soft or loose soil.



Two Rohl Tampers Being Pulled by a Caterpillar Tractor

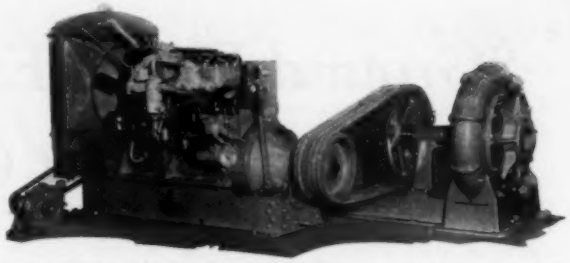
The rollers are carried in a frame, substantially constructed of structural steel having double drawbar attachments. The main shaft on which the rollers are mounted is 2 15/16 inches in diameter, and revolves in 4 heavy-duty cast iron bearings, fitted with Alemite connections.

Two New Engine Drives

TWO new engine drives have been announced by the Climax Engineering Co., 71 West 18th Avenue, Clinton, Iowa. One is a unique drive for sand pumps where it is not advisable to direct connect the engine to the pump. The other is a drive for any type of water pump.

The first type is especially popular with contractors and is designed for installation on barrel-type dredges to pump sand and gravel from the bottom of a river or lake to a sorting or screening bin on the shore or at the top of a hill. It is easily portable, and light in weight. It uses the Model-R4U, 6 x 7-inch, 85-horsepower engine, connected to a 6-inch sand pump with a special drive. This drive is taken from the engine by a Twin Disc inclosed clutch and through a Texrope drive which furnishes the necessary speed reductions between the engine and the pump, permitting the engine to operate on 950 r.p.m., and the pump at 625 r.p.m. Provision is also made for driving a service or priming pump from the front end of the engine.

In a recent test, the capacity of the unit delivered in excess of 1000 gallons of clear water per minute, or more than 30 cubic yards of solids, to a maximum height of 60 feet. The engine may be equipped with an electric starting and lighting outfit and operates from an ordinary drum by means of a vacuum tank and flexible tubing. The engine may be supplied with or without a radiator.



Climax R4U Engine Connected to a 6-inch H & B Allis-Chalmers Sand and Gravel Pump by Texrope Drive

The engine used in the second drive is Climax Model-KU, 4-cylinder, 5 x 6½-inch, and is conservatively rated with ample reserve power to drive a 6-inch water pump with a capacity of 1200 gallons per minute, against a 75-foot head. A unit of this type is suitable for semi-permanent or permanent installation; being mounted on its own base, it is easily portable.

A Stationary Motor Saw

IN the 20th Century woodworker of the Cresson-Morris Co., 18th Street and Allegheny Avenue, Philadelphia, Pa., the stationary motor reduces vibration and makes for accuracy. In crosscutting, the saw is pulled to the lumber, instead of feeding lumber to the saw, thereby saving effort on the part of the operator.

With a 10-inch saw and 1½-horsepower motor, this saw will crosscut 3-inch hardwood. With a 12-inch saw and 2-horsepower motor, it will crosscut 4-inch hardwood and with a 16-inch saw and 5-horsepower motor, 6-inch hardwood.

The cast iron table through which the rip saw works is also the operating table in crosscutting. In tilting the cast iron fence guide can be adjusted to any angle, making possible accurate work. By turning the swinging arm the saw can be made to cut at any angle. The operating table is raised or lowered by means of screws operated by a hand wheel through spiral gears. The saw is protected by a sheet metal guard which keeps the lifting screws free of saw dust, and acts as a chute in keeping the saw dust from spreading. The saw is especially adapted for dado work on either the crosscut or rip saw mandrel.

The Cresson-Morris 20th Century Woodworker

3C

COLUMBIA CALCIUM CHLORIDE

77–80%

SPEEDS UP CURING!

Cuts practically half the time from the usual delay in opening a new concrete road—saving time when time means money.

Economical? Yes!—Only two pounds of "3-C" Calcium Chloride to every 100 pounds of cement, when used in the gauge water—the surest, safest method.

Sold direct from our factory and through 40 distributors

Write for latest price quotations

3C Columbia Calcium Chloride is the most approved means of settling road dust. *Write for circular describing "Dust Prevention"*

COLUMBIA CHEMICAL DIVISION

The Pittsburgh Plate Glass Co.

BARBERTON, OHIO

Industrial Brownhoist CC Shovel Digging in Frozen Earth

A Sturdy, Small, Gas Shovel-Crane

A STURDILY-BUILT small machine of ⅝-yard shovel dipper or 6-ton crane capacity, Type-CC, has been developed by the Industrial Brownhoist Corporation, Cleveland, Ohio. It is convertible for use with dragline or trench hoe attachments. It is simple in design and possesses all the advantages demanded in a shovel or crane of its type. It is designed for road jobs as well as cellar excavation, sand and gravel pit use.

The simplicity of this many-purpose, crawler machine permits an unusually heavy construction for a machine of its capacity class, including a cast steel rotating bed-plate and car body. Unusually powerful and fast operating, the Type-CC makes a good dragline outfit, and it is equally good for trench hoe work.

Paper Bags Prevent Loss

STORIES of losses from the Mississippi flood of 1927 are still coming to light. One of the most interesting is the case of the B. W. Dodds Lumber Yard in Greenville, Miss., which was flooded out on April 22, 1927. The water reached a height that caused a lime fire in the warehouse, completely destroying the warehouse as shown in the accompanying illustration. This left the cement stored in Bates Multi-Wall paper bags exposed to the heavy rains from April 23 to June 13, during which time 11.61 inches of rain fell. The cement was sold to a local contractor for reconstruction purposes and was found in excellent condition. B. W. Dodds of Greenville is most enthusiastic over the five-wall paper bags made by the Bates Valve Bag Corporation, stating that "They eliminate all sack troubles and protect their contents."

Bates Multi-Wall bags are being used now in practically all parts of the country by different manufacturers of lime, cement, and other similar materials in preference to bags which must be returned to the material producer.

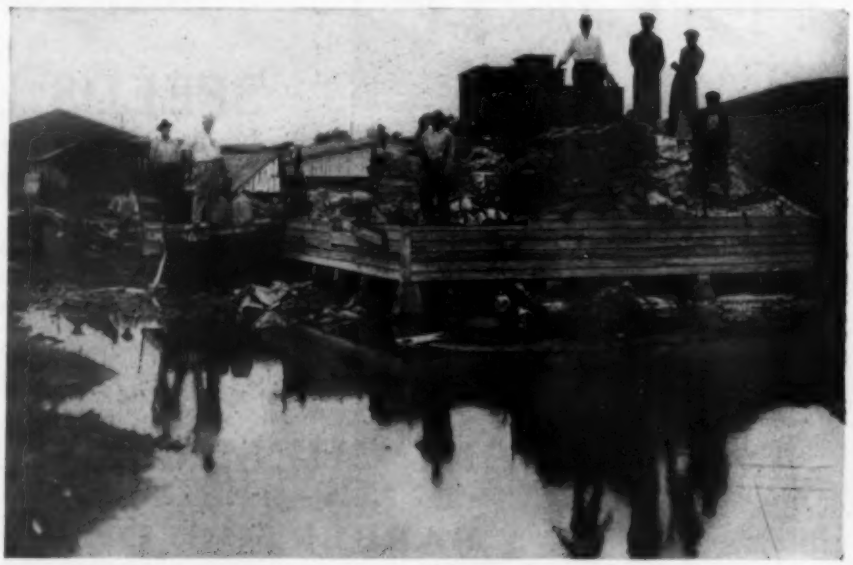
Calcium Chloride As an Admixture

GREAT strength, speed in hardening, uniform curing throughout the entire thickness of the concrete, and the distribution of moisture are but a few of the features of using calcium chloride produced by the Solvay Sales Corporation, 40 Rector Street, New York, for concrete construction. This product is also a valuable adjunct to concrete for cold weather work, in that it not only reduces the freezing point of water, but its accelerating action generates additional heat which reduces considerably the time usually required for protecting concrete, and is an added factor of safety.

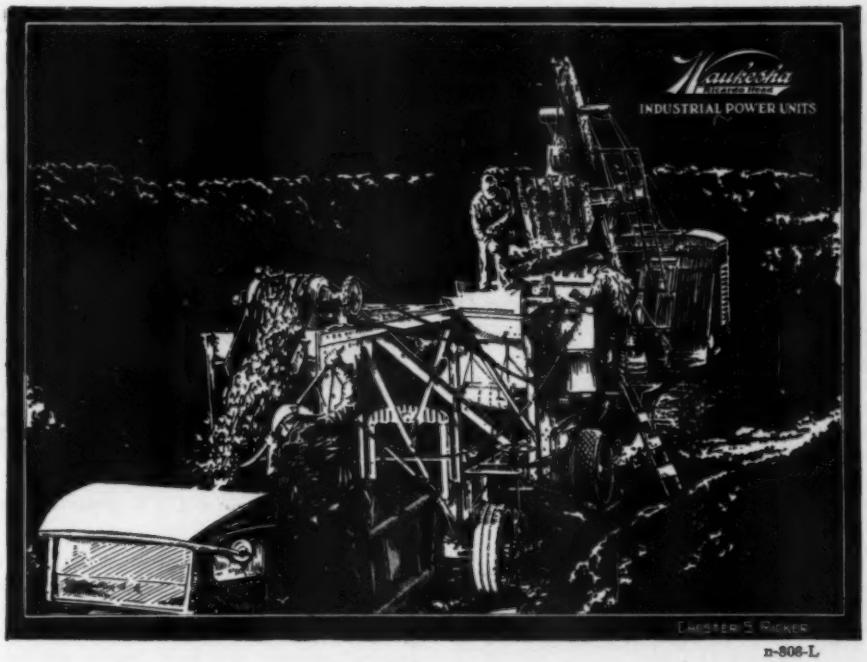
When calcium chloride is incorporated in the mix less water may be used to obtain the same degree of workability as concrete prepared under usual conditions, enabling the concrete to develop maximum strength by reason of its low water-cement ratio without sacrificing its workability. A fatty mix is produced which hangs together and prevents the segregation of its components and which at the same time is more easily handled and adapted for chuting and conveying. This is accomplished through holding the moisture uniformly throughout the concrete. Through the same action it enables the concrete to retain this moisture during the curing period, preventing shrinkage and causing the concrete to set to a more constant volume.

The most important effect of acceleration of hardening by calcium chloride is within the first few hours. According to the manufacturers, concrete pavements and floors cured with this product are hard enough to be walked on one hour after they are laid, and under average conditions, concrete that has been treated with the proper quantity of this flake will attain at the end of 48 hours the strength equal to that of untreated concrete at the end of 7 days.

That the incorporation of calcium chloride in portland cement concrete does not cause the corrosion of reinforcing steel has been established, according to the manufacturers, by data collected over a long period of years during which a careful study was made of this problem. The consistency of the mix and the manner in which the concrete is worked around the reinforcing are the vital factors in the cause and prevention of such corrosion.



Condition of the Dodds Warehouse at Greenville, Miss., After the Flood and Fire



n-806-L

Waukesha-Engined Portable Good Roads Gravel Plant in Action

They Must Not Quit

County and township road builders require good gravel to maintain their roads and streets. Combined crushing, screening and loading gravel plants of the portable type help keep costs down. But these plants require a fleet of trucks and a power shovel when in action. Shut-downs are therefore expensive. As insurance against such delays Waukesha "Ricardo Head" Heavy Duty Engines are standard equipment on the best known portable gravel plants.

A portable plant like the one above, which is shown in a Wisconsin municipal gravel pit, is self-propelled and completely self-contained. It will crush from 20 to 30 tons of gravel an hour with the crusher set at ¾-inch opening and at 50 percent larger opening will handle up to 60 tons per hour. A vibrating steel screen is used and a rubber-covered conveyor belt. To guard against breakdowns, heavy-duty ball and roller bearings are used and a fifty horsepower heavy-duty Waukesha engine supplies the power. Waukesha Industrial Power Units and Engines are built in units varying from 20 to 125 horsepower and suitable for a small pump or a power shovel.

N-819-L

INDUSTRIAL EQUIPMENT DIVISION

WAUKESHA MOTOR COMPANY

Waukesha Wisconsin

New York	Kansas City	Denver	Tulsa	Houston	San Francisco
8 W. 40th Street	*V. L. Phillips Co.*	*Wilson Machy. Co.*	*C. F. Camp Co.*	*Portable Rig Co.*	*C. A. Watts*

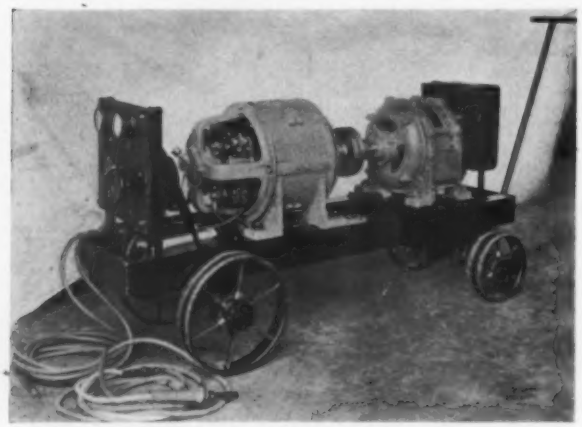
Exclusive Builders of Heavy-Duty Gasoline Engines for Over Twenty Years

Close Control in a Motor-Driven Welding Machine

WELDING machine operators who demand very close control of the welding current, and also a long arc and heavy current for rapid deposition of metal, will find the combination of these requirements in the Wilson Type-200 amperes Model-S one-arc, motor-driven electric welding machine of the Wilson Welder & Metals Co., Inc., Wilson Building, Hoboken, N. J. This machine has a welding range from 10 to 300 amperes, and the same type machine is available also with a welding range from 15 to 500 amperes in either one-arc, belt-driven units or one-arc, gasoline engine-driven units; also in two- arc motor generator units.

The control is equipped with a specially designed rotary switch with dial and pointer. By setting the pointer, any desired current value can be obtained by adjusting the open circuit voltage by means of the field rheostat. When the pointer is set on the maximum position, the voltage at the generator is that of the arc plus the drop in the welding leads and no ballast resistance is used in the circuit.

The generator is self-excited. The commutator of the generator is always the coolest part of the machine. No separate exciter or brush shift device is used to accomplish the close control. This feature and the very rapid voltage recovery make the machine well suited for overhead welding.



The Wilson One-operator Motor Generator 200 Ampere Welding Unit

The arc is easy to start and easy to maintain. This is accomplished by a properly proportioned reactance which automatically steadies the arc under all welding conditions.

The generator has been so designed as to give a full load of 300 amperes when welding, and the current will not rise much above that on short circuit, thereby reducing the liability of the electrode sticking to the work when striking the arc. The machine is capable of turning out fast work with electrodes up to 3/8-inch diameter.

A Mixer on Cushion Tires for Fast Travel

A ONE-BAG 7-S mixer, Model 7L-2R, that has been put on cushion tires for fast travel, and that has a patented automatic skip shaker loader, has been produced by The Jaeger Machine Co., 701 Dublin Avenue, Columbus, Ohio. This mixer has been approved by state highway departments and is recommended as an all-purpose size.

The Jaeger Model 7 L-2 R Mixer on Cushion Tires

This mixer holds a bag of 1-3-6-mix, and can be operated economically on small or large jobs. It is light, being nearly of all steel, is compact and short coupled, and its roller bearing steel or cushion tire wheels add to the easy portability. The patented automatic skip shaker loader, eliminating pounding on the bottom of the skip, saves time and increases yardage.

The mixing drum is the Jaeger semi-steel cast bowl with "flat spots" in the lower half to give a folding action. It has twin mixing paddles to give slicing and shoveling actions to the aggregate, thus insuring a uniform and speedy mix and a fast, clean discharge. The drum shaft bearing is fully Timken-equipped. The roller bearings are located in water and dust proof housing. A large grease chamber provides ample lubrication.

The carrying drum is made of semi-steel I-section, heavily ribbed and reinforced. The automatic knockout is a simple, rugged and positive control to raise and hold the loader bucket in its highest position after the clutch is engaged by hand.

Both clutch and brake are operated by one lever. A 2-cylinder, 6-horsepower, hopper-cooled Le Roi engine, ruggedly built for constant service duty is fully enclosed in a sheet metal cab with lockable doors.

Not so Bad as it Looks. A Caterpillar Tractor Backing a Miami Scraper Over the Edge of the Bank to Dump

Surfacing and Mixing Cut Back Asphalt and Aggregate on the Roadway

Completed Roadway with Two Inch Asphaltic Concrete Wearing Course

Resurfacing by Retread Method Using

Stanolind Cut Back Asphalt

Asphalts for Every Purpose

STANDARD OIL COMPANY
(INDIANA)

General Offices: 910 S. Michigan Avenue CHICAGO, ILLINOIS

ILLINOIS	INDIANA	IOWA	S. DAKOTA	N. DAKOTA	Green Bay	MISSOURI
Chicago	Evansville	Davenport	Huron	Fargo	MINNESOTA	Kansas City
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Peoria	KANSAS	Sioux City	Grand Rapids	La Crosse	Minneapolis	
Quincy	Wichita		Saginaw	Milwaukee		

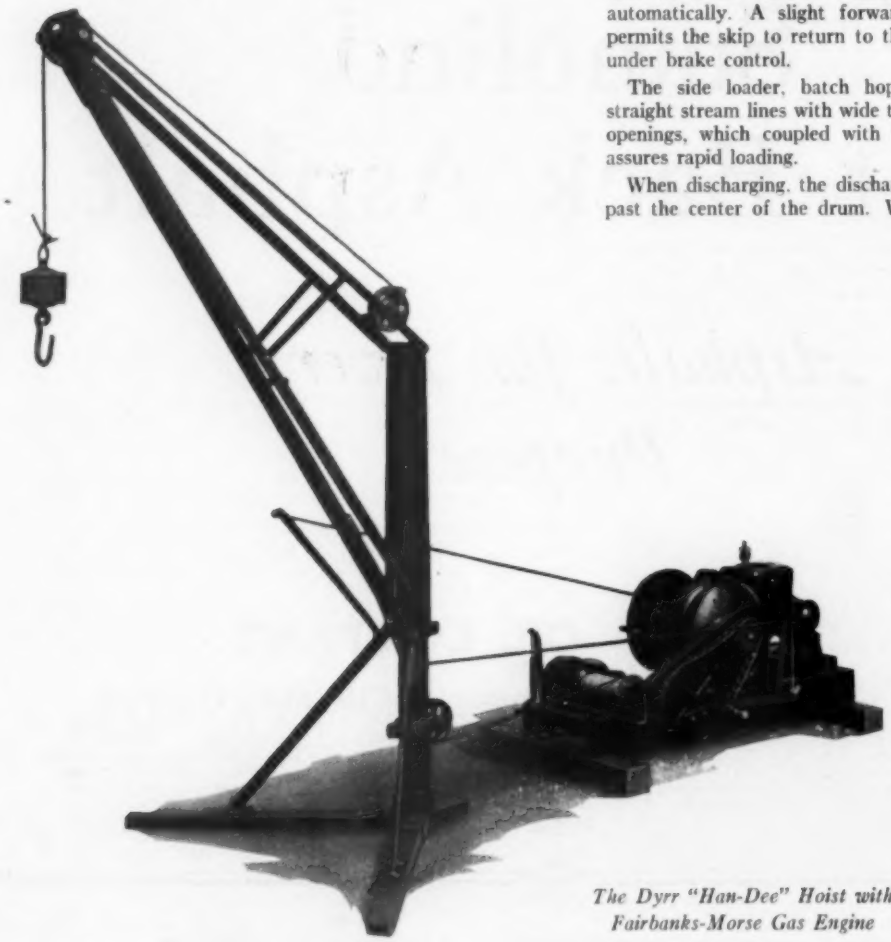
A Safe, Fast Hoist

A NEW "Han-Dee" hoist, manufactured by the Dyrr Manufacturing Co., 378 Bickett Street, Huntington Park, Calif., handles loads up to 500 pounds on a single line at a speed of 100 feet per minute, and 650 pounds at a speed of 75 feet per minute. With a double line and snatch block it will carry nearly twice the load at half the speed. This hoist is simple in construction and easily assembled and transported from one part of the job to another.

Two men can unload the hoist from a small truck and locate it on the top floor of a structure ready for work within one hour's time. It is in four parts: the engine, the hoist, the stand and the boom. It is simple and easy to operate, and will keep eight bricklayers supplied with brick and mortar. It can be operated on the ground, on the top floor, or anywhere the operator can reach the two control lines. The operator can stand in position to always watch the load as it ascends and descends.

A 2-horsepower Fairbanks-Morse "Z" magneto-equipped gas engine is a single unit and is easily attached. The load can be stopped whevere desired, since the brake works instantly and automatically, holding the load at any desired height.

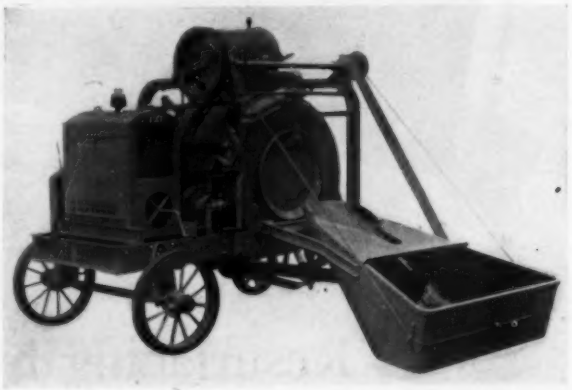
The boomstand is made from 3½-inch pipe and two pieces of 3-inch channel iron, well braced and of substantial construction. The boom is made from angle-iron and malleable castings, and will swing in a full circle, thereby enabling the operator to land the load at any desired point. The lower bearing is hinged, and by pulling a cotter key it can be easily taken down from the stand.



The Dyrr "Han-Dee" Hoist with Fairbanks-Morse Gas Engine

A Mixer Incorporates New Features

A NEW mixer that is automatic in its operation of loading and discharging, that can be turned around in its own length and has an automatic side-loader hoist, has been developed by Norris K. Davis, San Francisco, Calif. The



The Davis Mixer with Automatic Side-loader Hoist

hoist can be operated from either side of the mixer. The operator after throwing the hoist lever forward is free for other work, because when the skip reaches the discharge position the hoist clutch is disconnected and the brake applied automatically. A slight forward pressure of the hoist lever permits the skip to return to the charging position by gravity under brake control.

The side loader, batch hopper or charging chutes have straight stream lines with wide throats that fit the 22-inch drum openings, which coupled with the proper angle of discharge, assures rapid loading.

When discharging, the discharge chute is projected into and past the center of the drum. When not discharging it swings out and clear of the drum.

The discharge chute may be locked automatically in either mixing or discharge positions until the reverse position is desired.

The blades are the central suspension type that use the entire drum for mixing, yet centralize the batch. As the material is gathered by the blades at the bottom it is carried upward, and, due to blade construction, rolls, falls and slides to the center, where it is poured on the backs of the descending blades, imparting a cutting under, elevating, siding, pouring and spreading action. A space is left between the drum shell and the bottom of the blade, permitting a wash under that constantly washes the drum clean, there being no pockets for solidification.

Contractors will find the new features of this mixer make for increased efficiency in operation and a valuable aid to construction.

WATER SUPPLY . . . . FIRE PROTECTION . . . . SEWAGE DISPOSAL

No hot lead: no cold lead:
no pouring: no calking . . .

LABOR-SAVING simplicity and unfailing dependability are the outstanding characteristics of Universal Cast Iron Pipe. All jointing materials eliminated. Nothing to deteriorate—nothing to work loose in these *flexible* machined iron-to-iron joints.

Laid practically anywhere in any season. Curves laid with straight lengths. Easier. Quicker. Safer. *Wrenches the only tools.*

For Dependable Water Supply, Fire Protection, Sewage Disposal address nearest office.

UNIVERSAL CAST IRON PIPE

No bell holes to dig: No joints to calk

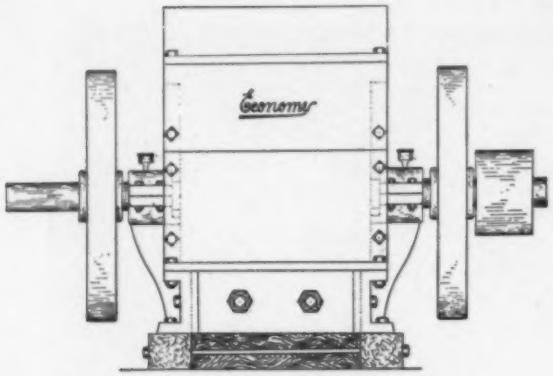
THE CENTRAL FOUNDRY COMPANY

Subsidiary of The Universal Pipe and Radiator Company

Graybar Building, 420 Lexington Avenue

Chicago Birmingham New York Dallas San Francisco

Above view:—Two 12-inch Universal Pipe Lines—River Crossing



Closed End View of the Economy Crusher

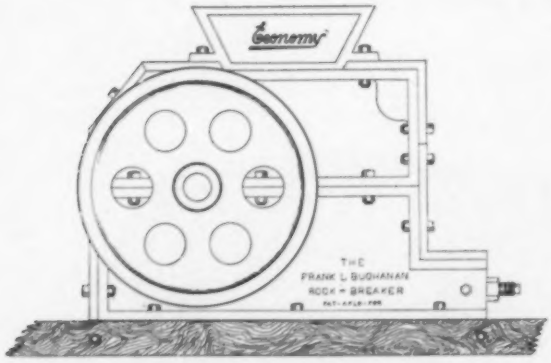
A Rock Breaker and Granulator

AN economy rock breaker and granulator has been developed by The Economy Equipment Co., Suite 644, I. W. Hellman Building, Los Angeles, Calif. Its low cost, light weight, low power requirements, and low upkeep costs make it popular with contractors in the rock crushing field. It is adaptable to the size-reduction of practically all classes of material regardless of character. It will reduce input size to minus one-half-inch cubiform material by sufficient stage reduction.

The capacity of this unit is positive and large per unit of input power, since it takes every advantage possible of the friability, cleavage, fracturing and old fractures of the material reduced. Little power is required for operation, because there is no heavy starting torque, no dead load to swing or lift, and the material is instantly discharged when reduced to the desired size.

The actual metal wear in this machine is low, because metal contact with the material being reduced takes place only the instant that breaking is done. Maintenance costs are low because of few wearing parts. The two drive shaft bearings are of substantial standard design, protected from grit and dust. Ample provision for positive lubrication is provided. Operating at high efficiency does not require a high speed, from 200 to 400 being necessary for primary breaking and from 500 to 800 for granulating.

Proper feed input size assures the dependable uniformity of cubiform products devoid of spalls or slabs. The selective reduction action and instantaneous discharge assure minimum fines and oversize. The light weight and mechanical balance of the machine require an inexpensive foundation, and the minimum of headroom is required.

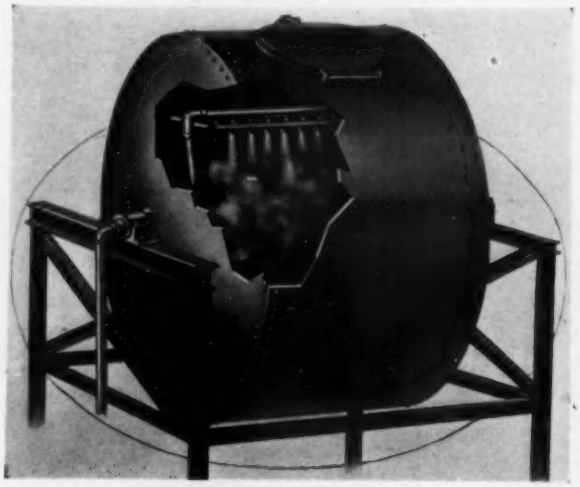


Side View of Economy Crusher

A Pressure Mixer for Asphaltic Concrete

IN an endeavor to improve on the old, well-known pug-mill for the preparation of topping and black base for asphalt pavements, the American Fin-Mix Co., 474 Wrigley Building, Chicago, Ill., has developed a rotary pressure mixer which has proved effective.

This mixer consists of an enclosed drum, the cover of which can be sealed. The drum has one hollow trunnion through which passes the pipe by which the liquid bitumen is brought into the mixer when it is closed. The drum is equipped with shelves which pick up the aggregate of rock and sand, raise it and permit it to cascade in the drum. The cascading material



The Finley Rotary Pressure Asphalt Mixer

is sprayed with the liquid asphalt, which is brought through the trunnion and distributed through spray nozzles on a transverse pipe inside at the top of the drum. On one side of the drum is the sprocket gear and on the other side is the brake band.

It is reported that only 25 horsepower is required to run the 7½-ton mixer, and that approximately 15 horsepower is all that is necessary for a 5-ton mixer. The reason for so little power being required, according to the manufacturer, is that instead of forcing the blade through the mixture of rock and asphalt as with the ordinary type mixer in the Finley rotary pressure mixer the material is simply lifted by the shelves in the drum for a short distance and allowed to cascade, thus exposing its surface to the liquid asphalt spray. After the asphalt has been added to the aggregate, the drum is subjected to an air pressure of 50 pounds, using the same pipe as that used for bringing in the asphalt. This air pressure is said to force the bitumen into the surface crevices of the material, thus insuring a complete bond between the asphalt and the treated aggregate.

He who is false to present duty breaks a thread in the loom, and will find the flaw when he may have forgotten the cause.

—Henry Ward Beecher.

Florida's sun can't make it run
...and at zero it wouldn't be brittle!

THE above photograph, taken at White City, Florida, shows the remarkable flexibility of Carey Elastite Expansion Joint. It bends and flexes, limber as leather harness. Easy to handle, and it keeps its shape in any weather.

Broiling sun can't melt it; frost can't make it brittle. How it does stand up in service!

Carey Elastite Expansion Joint is used in practically every state in the Union. For in this season-proof material leading construction engineers recognize the unfailing means of protecting concrete against disintegration. Our free booklet will give you the facts—write for your copy today.

Carey Elastite Expansion Joint consists of a heavy body of fibrous asphaltic compound, sandwiched between two layers of asphalt-saturated felt. Made in preformed strips, in various lengths, widths and thicknesses. Common labor can install it easily, with ordinary tools.

THE PHILIP CAREY COMPANY
Lockland, Cincinnati, Ohio

Carey Elastite
EXPANSION JOINT

These especially selected catalogs and pamphlets of value to contractors are for free distribution.

BOOKLETS FOR BUSY CONTRACTORS

You will find it worth while to check these lists each month and write for the catalogs you need.

AN ALL-STEEL HAND HOIST

A general utility all-steel hand hoist that is built of high grade electric steel, is practically indestructible, compact, and simple, and has a capacity of 5 tons straight line, is described in illustrated circulars of Beebe Bros., 3219 First Avenue, South, Seattle, Wash., which will be sent to interested engineers and contractors.

COMBINATION CUTTING AND WELDING TORCH

Booklet No. 172, describing Milburn Types RI and NI combination cutting and welding torches, as well as other torches, regulators and acetylene generators, will be sent upon request to the Alexander Milburn Co., 1416 West Baltimore Street, Baltimore, Md.

TIME AND MONEY SAVING HOISTS

Reversible and non-reversible hoists that are furnished complete with "New Way" air-cooled engines, have been produced by the Universal Hoist & Manufacturing Co., 200 East 14th Street, Cedar Falls, Iowa. These hoists are made in two sizes and have a rated lifting capacity of 1000 to 1800 pounds. They are described in an illustrated circular of the company.

WORKABLE CONCRETE

The proper workability of concrete produces the beneficial qualities desired in concrete construction—uniformity, high effective strength, water tightness, lower costs for handling and placing and the assurance of good-appearing concrete. The Celite Products Co., 1320 South Hope Street, Los Angeles, Calif., in its Bulletin Form 336, gives valuable information regarding the use of Celite in producing higher strength, more workable concrete.

PLUNGER TRENCH PUMPS

Bulletin No. 21D of The Barnes Manufacturing Co., Mansfield, Ohio, describes plunger trench pumps that handle muddy water, sewage or any liquid thin enough to flow, and especially describes Duplex Model-L308A, which develops 25 to 26 inches vacuum, raising the liquid 25 feet by suction and discharging it through a hose or pipe 20 to 30 feet above the outfit. This Bulletin will be sent on request, to interested parties.

A NEW 14-S STANDARD BUILDING MIXER

Simplicity is the outstanding feature of the new 14-S standard building mixer of the Ransome Concrete Machinery Co., Dunellen, N. J., which is capable of handling a 3-bag batch of 1:2½:4. This new machine is described and illustrated in a special bulletin, "A Three Bagger," which the company will send on request to interested contractors and engineers.

TWO NEW ENGINE DRIVES FOR CONTRACTORS

Two new engine drives have been announced by the Climax Engineering Co., 71 West 18th Avenue, Clinton, Iowa, and are described in literature of the company. One is a unique drive for sand pumps where it is not advisable to direct connect the engine to the pump. The other is a drive for any type of water pump. Write for detailed information and illustrations.

A NEW HAND HOIST AND DUMP BODY

A new 1½-ton dump body and hand hoist, No. 15, for use on the new Ford truck "AA," has been described in a new circular of the Marion Steel Body Co., Marion, Ohio. This new dump body has been doubled in strength for the full capacity of the new Ford, a safety device is applied to the crank, and other features make this an interesting proposition for the material-hauling contractor.

A SINGLE-SHAFT DRIVE CRAWLER MOUNTING

A single-shaft drive crawler-type mounting for shovels and cranes, with few parts, extra strength, and many desirable features, has been described in literature of the Bucyrus-Erie Co., Erie, Pa., which is available on request.

A NEW LINE OF SCREW JACKS

Many improvements in design and finish mark the introduction of a new line of screw jacks, which Templeton, Kenly & Co., Ltd., 1020 South Central Avenue, Chicago, Ill., has described in an illustrated piece of literature that is available on request.

A TRACTOR-POWERED GRADER

A heavy-duty motor grader with the Caterpillar 2-ton tractor as the power unit, has been produced by The Galion Iron Works & Manufacturing Co., Galion, Ohio, and is described in a new bulletin which the company will be glad to send to interested contractors and engineers.

A MULTIPLE ROOTER PLOW

An improved rooter plow, the Graderooter, that is equipped with double pointed teeth, made of high grade steel one inch thick, that can be set to root 12 inches deep and 48 inches wide, is described in literature of the Lakewood Engineering Co., Cleveland, Ohio.

A NEW 20-H.P. TRACTOR

A new model tractor designated as the Caterpillar Twenty, with a gasoline engine developing 20 horsepower at the drawbar, and built to fit into the line of the Thirty and Sixty, as well as the smaller 2-ton tractors, is described in literature of the Caterpillar Tractor Co., San Leandro, Calif.

EXPLOSIVES—KINDS AND USES

E. I. Du Pont de Nemours & Co., Inc., Explosives Dept., Wilmington, Del., has issued a particularly valuable table which completely lists the various kinds of Du Pont explosives and the uses to which they are adapted. A copy of this Bulletin A-2455 may be secured free on request by any contractor interested.

A MECHANICAL MAN PAVER

A mechanical man device to be attached to the 27-E Rex paver has been developed by the Chain Belt Co., 766 Park Street, Milwaukee, Wis. This device performs all operations with sureness and accuracy, and is described in literature which the company will gladly send on request, to interested parties.

FLEXIBLE ARC WELDERS

Several hundred models comprise the line of flexible arc welders of the Fusion Welding Corporation, 103rd Street and Torrence Avenue, Chicago, Ill. The line includes a wide choice of drives and the welders are available in various sizes and in stationary and portable types. They are described in an illustrated bulletin of the company which will be sent on request.

A 3-SPEED CRANE WITH AUTOMOTIVE SHIFT

Flexibility is one of the major features of the new "American" gasoline 3-speed crane of the American Hoist & Derrick Co., St. Paul, Minn., which has an automotive shift that works like the transmission on your automobile, has varying speeds for facilitating material handlng, and a machinery deck that revolves on 20 bronze-bushed conical rollers. This new unit is described in literature of the company.

STRONG, EFFICIENT CABLE DRAGLINES

Catalog No. 36 of The Mundy Sales Corporation, 30 Church Street, New York, distributors for the Schofield-Burkett Construction Co., Macon, Ga., describes completely and illustrates the various types of cable draglines of that company and their uses, as well as excavating machines and hoists.

A VARIETY OF POWER PUMPS

Hydraulic Tables—Data 50, telling all about the vertical, horizontal, triplex and quintuplex power pumps of The Aldrich Pump Co., foot of Pine Street, Allentown, Pa., will be sent on request to interested contractors and engineers.

TRACTORS THAT SPEED UP THE JOB

Ease of operation, full-crawler tracks, and the small turning radius of JT tractors are just a few of the many desirable features described in literature of The JT Tractor Co., E. 179th and St. Clair Avenue, Cleveland, Ohio.

ASPHALTS FOR EVERY PURPOSE

Stanolind paving asphalt and Mexican paving asphalt for every purpose of good highway construction are adequately described in literature which the Standard Oil Co. of Indiana, 910 S. Michigan Avenue, Chicago, Ill., will send on request.

DEPENDABLE POWER FOR CONSTRUCTION MACHINERY

Power for construction machinery that is both dependable and economical is described in literature of the Stover Manufacturing & Engine Co., 15 Lake Street, Freeport, Ill., that tells all about Stover engines that are Wico-magneto-equipped.

ECONOMY IN LOCOMOTIVES

Low cost haulage is possible and locomotive standby expense eliminated, as well as troublesome flues and grates, by the use of gasoline or electric Whitcomb locomotives that are made in sizes from 3½ to 50 tons, for all track gages, and which are described in literature of the Geo. D. Whitcomb Co., Rochelle, Ill., available on request.

STEEL SHEET PILING

Wemlinger, Inc., 149 Broadway, New York, will be glad to send complete information concerning steel sheet piling to contractors and engineers interested.

STERILIZED WATER IN FLOOD TIME

Continuous chlorination that costs but one cent per head per year and absolutely prevents water-borne disease, is described in literature of Wallace & Tiernan Co., Inc., Newark, N. J., manufacturers of the W & T chlorinator and other chlorine control apparatus.

LARGE FITTINGS AND SPECIAL CASTINGS

The services of the United States Cast Iron Pipe and Foundry Co., Burlington, N. J., that has unusual facilities for handling large standard fittings and for making especially heavy castings, are described in literature which the company will gladly send to contractors and engineers.

PROFIT MAKING TRUCK CRANES

Profit making uses of Universal motor truck cranes of The Universal Crane Co., 957 Swetland Building, Cleveland, Ohio, are decsribed in literature which will be sent to parties interested in this type of equipment.

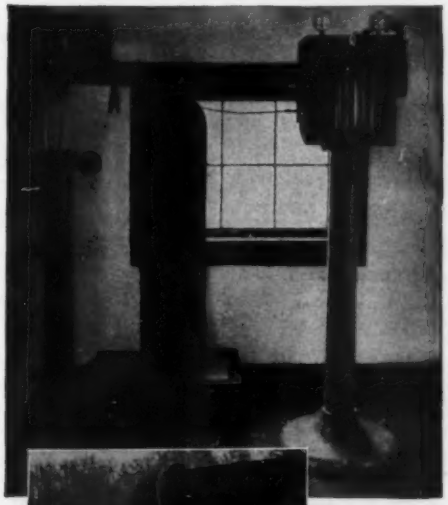
PROTECTION FOR CONCRETE CURBS

Concrete curbs that eliminate maintenance charges, give permanent protection to the exposed edges of curbs and prevent cracking and chipping, and that are made in 8, 10 and 12-foot lengths which can be furnished bent to radius when required, are described in literature of the Truscon Steel Co., Youngstown, Ohio.

SEMI-TRAILER HITCHES

Semi-trailer hitches and construction tractor accessories of the Trail-iT Co., St. Paul, Minn., are completely described and illustrated in literature which the company will be glad to send on request.

All Well Waters —Should Be Chlorinated!



THE ELIZABETHTOWN WATER COMPANY, ELIZABETH, NEW JERSEY *uses the new* W & T CHLORINATOR *Type MSP to sterilize every drop of well water.*

PUBLIC HEALTH ENGINEERS are rapidly dissipating the old-fashioned but popular idea that well waters are pure and safe to drink just because they are well waters and come from under-ground sources.

They know that well waters are liable to pollution—that a fissure in the rock or a break in the well casing often permits disease ladened contamination to enter the supposedly pure water—particularly in times of flood.

They know that hundreds of Typhoid Fever Epidemics have been caused by well waters.—They know that the three outstanding typhoid epidemics in recent history—Salem, Ohio—Lansing, Michigan—Santa Anna, California—were all caused by polluted, *unchlorinated* well water.

That is why there is a marked tendency toward the chlorination of all well waters—because a properly chlorinated water cannot cause disease—because chlorination will not change the physical or chemical characteristics of the water in any way—because chlorination costing but one cent per capita per year is the cheapest public health insurance.

"The Only Safe Water is a Sterilized Water"

WALLACE & TIERNAN

COMPANY, INCORPORATED

Manufacturers of Chlorine Control Apparatus

NEWARK • NEW JERSEY

NEW YORK CHICAGO KNOXVILLE SAN FRANCISCO MINNEAPOLIS PITTSBURGH DALLAS KANSAS CITY
LOS ANGELES SEATTLE ST. LOUIS BUFFALO HARRISBURGH INDIANAPOLIS DETROIT
WALLACE & TIERNAN, LTD., TORONTO, CANADA WALLACE & TIERNAN, LTD., LONDON, ENGLAND

BARROWS, CARTS AND SCRAPERS
Catalog specifications and data on the Bull Frog line of barrows, carts and scrapers for every purpose, that cut the cost of material handling and enable you to get more work out of your men, will be sent to you, on request, by The Toledo Wheelbarrow Co, Toledo, Ohio.

A NEW BACK-DIGGER
The Tiltable dipper on the new Thew back-digger now makes it possible for the operator to control the angle of the dipper at all times, and has five new back-digger advantages, chief of which is the ability to hold the load until spotted over spoil-pile or truck, then dump quickly and cleanly. This back-digger can be quickly and easily attached to any Lorain 60 or 75 machine in the field, and is described in literature of The Thew Shovel Co., Lorain, Ohio.

A SUPER-CHARGER FOR THE PORTABLE COMPRESSOR
The Rix super-charger of the Thor 6 portable compressor is a simple, patented construction that enables the compressor to deliver 26 per cent more air and gives the unit a capacity of 116 cubic feet and actually delivers 96 cubic feet. It is described in literature of the Independent Pneumatic Tool Co., 600 W. Jackson Boulevard, Chicago, Ill.

A NEW TRAILER MIXER
The new No. 3½ trailer mixer of the Kwik-Mix Concrete Mixer Co., Port Washington, Wis., that features the new friction tilting device that gives more speed, greater ease, and better work, is illustrated and described in a new catalog of the company, which also tells all about this company's line of tilting mixers, plaster, mortar mixers and pumps.

RIGID AND STRONG WHEELBARROWS
Properly balanced barrows that carry the load over the wheel, have V-formed front braces that give great strength and rigidity to both tray and frame, that can't wobble, and cost less per job to use, are described in literature of the Sterling Wheelbarrow Co., Milwaukee, Wis.

A ONE-MAN GRADER
A circular of the W. A. Riddell Co., Bucyrus, Ohio, describes and illustrates the Model "E" one-man grader that is a rugged and ready WARCO piece of equipment with independent scarifier, head-type steering gear, massive I-beam frame, reinforced mold board and blade lock.

TRUCKS AND INDUSTRIAL TRACTORS
A McCormick-Deering tractor that is powerful, compact, sturdy, flexible, has many uses, pulls, pushes, and lifts, and that has generous power going three ways—through drawbar, belt, and power take-off, is described in literature of the International Harvester Co. of America, Inc., 606 S. Michigan Avenue, Chicago, Ill.

BRONZE WATER METERS FOR SERVICE
A catalog giving details of Trident and Lambert meters that are bronze corrosion-resisting meters of the latest designs and that give an accurate and dependable register, will be sent to interested parties by the Neptune Meter Co., 50 East 42nd Street, New York.

DIAPHRAGM PUMPS AND MIXERS
The new ½-bag Lauson compact mixer and the Lauson diaphragm pumpers with gas or electric motor, are described in detail and illustrated in literature which The John Lauson Manufacturnig Co., 11 Jackson Street, New Holstein, Wis., will be glad to send on request.

SINGLE- AND DOUBLE-DRUM HOISTS
Single- and double-drum, reversing and non-reversing hoists that are ruggedly built for hard service, and that operate at low costs, saving time and labor, are described in literature of the Pioneer Tractors, Inc., Winona, Minn.

REINFORCED CONCRETE PIPE
Precast reinforced concrete sewer pipe that is easy to lay properly and has the least frictional resistance to flow is described in literature of the Newark Concrete Pipe Co., 462 Broad Street, Newark, N. J.

A CRADLE-LIKE GRAVITY DUMP BODY
A cradle-like gravity dump body that is made to be mounted on any 1-ton or 1½-ton truck, has the center of the load riding 8½ inches ahead of the rear axle, and has a simple positive locking trip lever, which operates the body both in dumping the load and returning the body to road position, is described in literature of The Galion Allsteel Body Co., Marion, Ohio.

DOUBLE-ACTING PILE HAMMERS
Double-acting pile hammers for heaviest concrete sheet and bearing piles, submarine pile driving, timber and pipe piles, heavy steel cylinders, heaviest and lightest steel and wood sheeting, demolition, etc., and that come in ten sizes, are described in catalogs which the McKiernan-Terry Drill Co., 19 Park Row, New York, will send on request.

CALCIUM CHLORIDE FOR CONCRETE CURING
Facts and figures of calcium chloride for concrete curing and road dust prevention will be sent to interested contractors and engineers by The Columbia Chemical Division of The Pittsburgh Plate Glass Co., Barberton, Ohio.

TAR HEATERS BUILT FOR SERVICE
Pamphlet No. 15 on the new oil burning heater of The Jos. Honhorst Co., 1016 W. 6th Street, Cincinnati, Ohio, tells all about the portable and stationary tar heaters of that company that come in capacities of 25 to 200 gallons.

DEPENDABLE POWER FOR EVERY PURPOSE
Heavy-duty Red Seal Continental motors that furnish economical gasoline power, speeding up operations and cutting construction costs are described in pamphlets of the Industrial Equipment Division of Continental Motors Corporation, Muskegon, Mich.

BRIGHTER LIGHTS FOR PROTECTION
Literature describing Little Wizard cold blast lanterns that, because of their high-power lighting, small size and low cost, are used extensively on construction work, affording the utmost protection to contractors against damage claims, and that are 11½ inches high, have 6 candlepower and burn 20 hours, will be sent by the R. E. Dietz Co., New York.

PIPE CUTTERS THAT REDUCE COSTS
A circular of the Ellis & Ford Manufacturing Co., 32 Piquette Avenue, Detroit, Mich., describes the Ellis pipe cutter that is made in two sizes to cut all kinds of pipe from 4 to 12 inches, and that saves its initial cost in one cut.

EARTH-MOVING EQUIPMENT THAT PAYS FOR ITSELF
Miami earth-moving equipment built for Fordson, Cletrac, McCormick-Deering and Caterpillar tractors, including the Miami scraper, bulldozer and backfiller that are power operated through the Miami winch, are described in detail in circulars of The Miami Trailer-Scraper Co., 610 S. Clay Street, Troy, Ohio.

3 TO 160-HORSEPOWER ENGINES
Dependable and low cost power per day and year is available with the use of Le Roi engines of 3 to 160 horsepower capacity that are described in literature of the Le Roi Co., Milwaukee, Wis.

BUYING ON PERFORMANCE
Catalog No. B-10, describing Link-Belt shovels that are bought on performance and that have among their features, speed, reliability and durability, will be sent on request, by the Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.

PERFECT ADJUSTMENT WITH THESE CLAMPS
Complete information will be furnished on request, by the M & M Clamp Co., 2 Fifth Street, S. E., Minneapolis, Minn., on the form clamps of that company which have perfect adjustment and do not require special tools for placing or releasing.

WATERPROOF GRAPHITE GREASE
Circular 148-W of the Joseph Dixon Crucible Co., Jersey City, N. J., describes waterproof graphite grease that possesses a remarkable adhesiveness and cannot be washed off, that cannot gum or become rancid, and is an unsurpassed rust preventive.

A MAGNETO FOR CONSTRUCTION EQUIPMENT
Th Eisemann magneto that is used throughout the country for construction equipment by discerning builders and contractors, is described in literature of the Eisemann Magneto Corporation, 165 Broadway, New York.

BETTER CURBS AND GUTTERS
Simplified design making possible greater form setting speed and eliminating form faults is one of the many desirable features of the forms of The Heltzel Steel Form & Iron Co., Warren, Ohio. The division plates are made with wings which extend through slots in the rails their entire depth, making rail spreading impossible and avoiding creeping. These forms are thoroughly described in literature of the company.

EARTH-MOVING EQUIPMENT
Shovels, ditchers, skimmers, draglines and cranes of the Insley Manufacturing Co., Indianapolis, Ind., are described and illustrated in circulars of the company which are available on request.

4-CYLINDER MOTOR ROLLERS
The motor roller catalog of The Huber Manufacturing Co., 330 Center Street, Marion, Ohio, describes Huber 4-cylinder motor rollers that are powerful and dependable, quick in action, economical to operate and made in 4 sizes—5, 7, 10 and 12 tons.

A ROAD BUILDERS LINE
Catalogs describing the Acme line of road rollers, power graders and scarifiers, self-propelled and stationary crushers, that will help you get that road job done on time, will be sent to interested contractors and engineers by the Acme Road Machinery Co., Frankfort, N. Y.

EXPANSION JOINTS FOR HIGHWAYS
Elastite expansion joints for concrete pavements that give county roads a national reputation are described in literature of The Philip Carey Co., Lockland, Cincinnati, Ohio, which is available on request.

HOISTS FOR CONTINUITY OF OPERATION
Performance records of Clyde gasoline hoists, low operating costs, and continuity of operation are the features that make the hoists of the Clyde Iron Works Sales Co., Duluth, Minn., so desirable by contractors and engineers.

WOODWORKING MACHINERY
Literature of the American Saw Mill Machinery Co., 171 Main Street, Hackettstown, N. J., describes mortisers and other cost-cutting machinery of that company, that mean greater profits on the job.

CONCRETE SURFACERS
The Berg concrete surfacer and finisher that enables one man to do the work of four rubbing by hand, and that is made in electric and air-driven models, is described in literature of The Concrete Surfacing Machinery Co., 4669-71 Spring Grove Ave., Dept. F, Cincinnati, Ohio.

SUPERIOR PERFORMANCE IN ROLLERS
Circulars of The Buffalo-Springfield Roller Co., Springfield, Ohio, describe the full range of sizes in latest models of rollers, with or without scarifier or other attachments. These circulars will be sent on request.

AUTOMATIC CONVEYORS
Descriptive bulletins of the Chicago Automatic Conveyor Co., 1853 South 55th Avenue, Cicero, Ill., tell all about the portable automatic belt conveyors that are cutting loading and unloading costs for thousands of contractors.

AN EASILY HANDLED MIXER
The Thruadoor plaster, mortar or concrete mixer of the Blystone Manufacturing Co., Cambridge Springs, Pa., that can be wheeled through any 30-inch doorway and will give a more thorough mix, work dependably at a high rate of speed, keep 25 plasterers busy, and allow the use of 30 to 40 per cent more sand than in hand-mixing, is described in the Thruadoor circular.

MACHINES FOR SUBGRADING
Formgraders, road rooters, trail graders, test templates, true-grade scarifiers and true-grade planers of Ted Carr & Co., 939 North Avenue, Chicago, Ill., are described in pamphlets of the company.

A SMALL, HIGH SPEED HOIST
A new Model 15-S high speed hoist that has been designed primarily for the smaller operators and for the innumerable little jobs on every big project, and that is equipped with a 4-cylinder, 12-horsepower Le Roi power unit, is described in literature of The Brown Clutch Co., Sandusky, Ohio.

A NEW TYPE OF HIGHWAY GUARD
Catalog No. 169 of the Page Steel and Wire Co., Bridgeport, Conn., describes and illustrates a new type of highway guard that is a tough yet elastic fabric of woven wire that when hit hard, stretches, holding the vehicle securely, with a minimum amount of damage. This catalog is available to contractors and engineers interested.

A CHAIN FOR HEAVY LOADS
A high carbon, electrically welded chain for the Ford Tribloc hoist has been produced by the Ford Chain Block Co., 2nd and Diamond Streets, Philadelphia, Pa. It has great strength, will not stretch under heavy loads, and is described in literature of the company.

A 27-E PAVER WITH NEW DEVICES
A large illustrated folder on the new 27-E paver of The T. L. Smith Co., 1030 32nd Street, Milwaukee, Wis., has recently been published. This will be followed shortly by a 40-page catalog covering in detail every unit of this new paver which has many new devices, and describing particularly the use of Timken, Hyatt and SKF bearings and the Smith measuring tank. This literature is available to interested contractors and engineers on request.